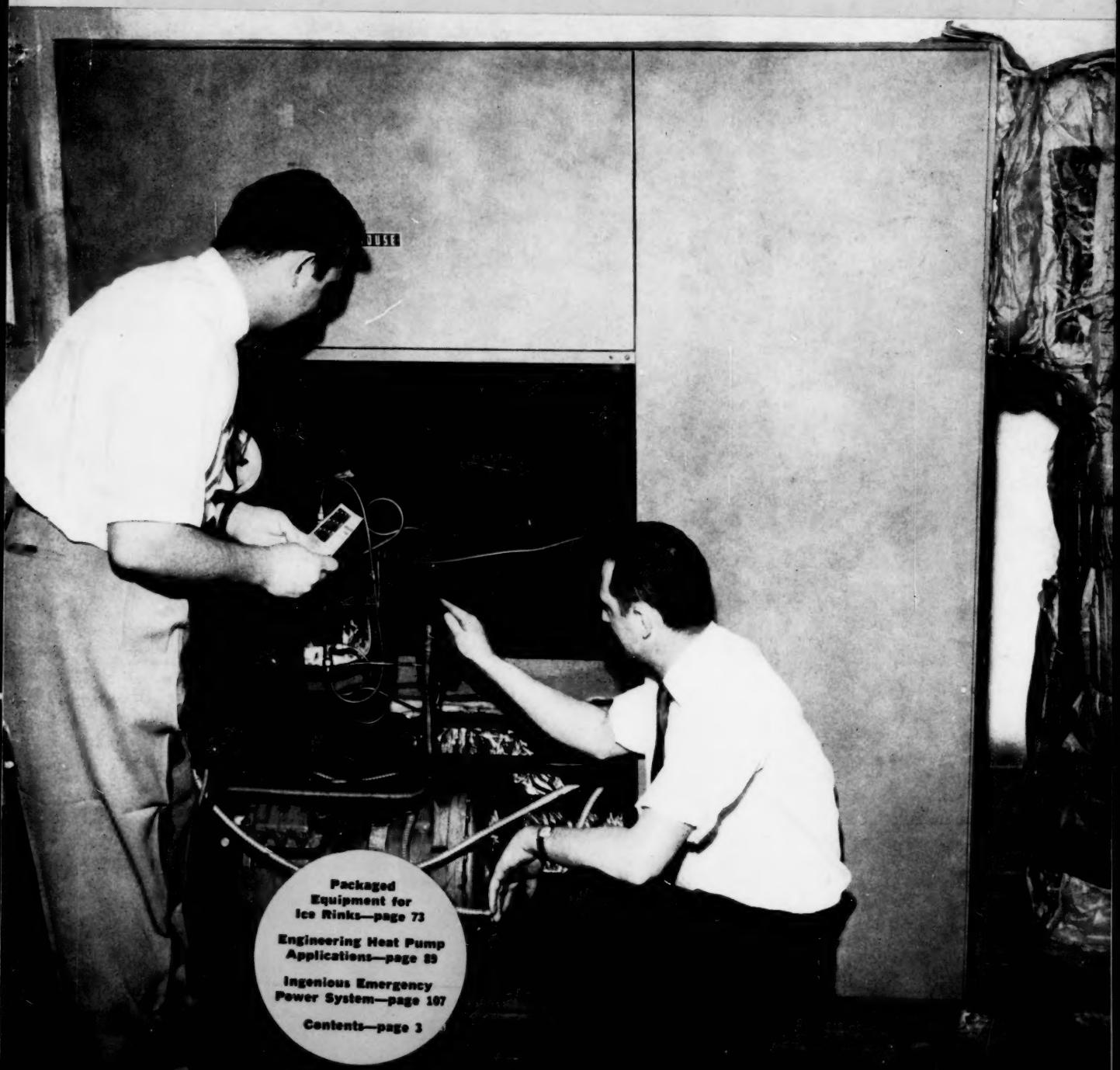
# AIR CONDITIONING HEATING AND VENTILATING

MAY, 1956 – 53rd YEAR



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Ingenious Emergency Power System—page 107

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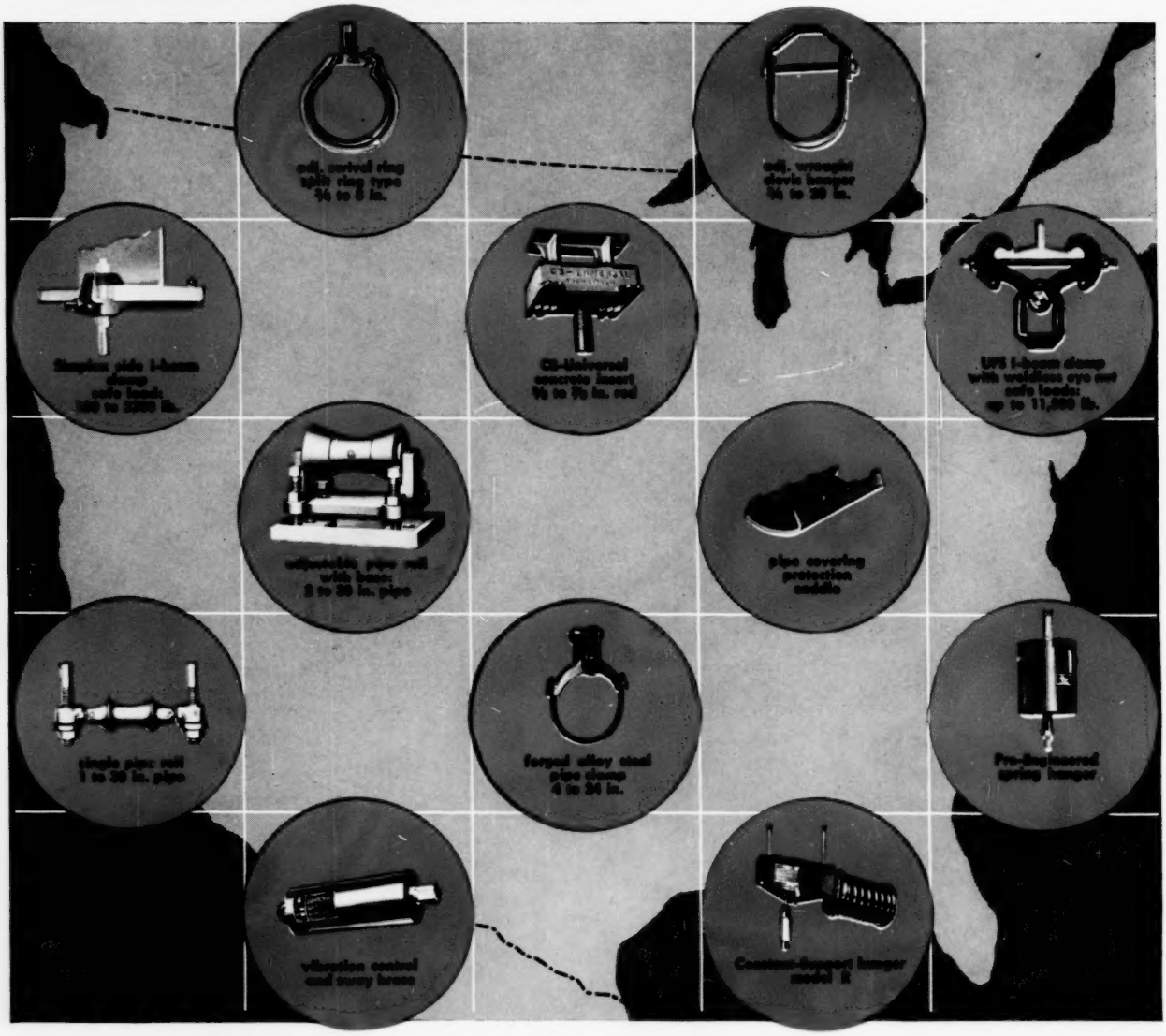
# GRINNELL OFFERS YOU



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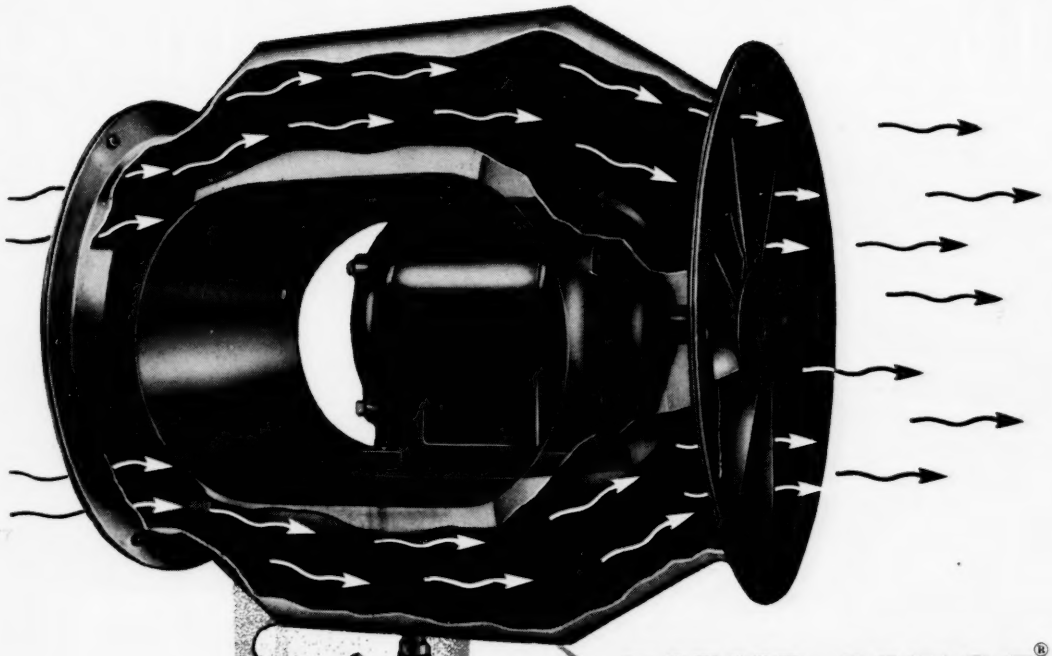

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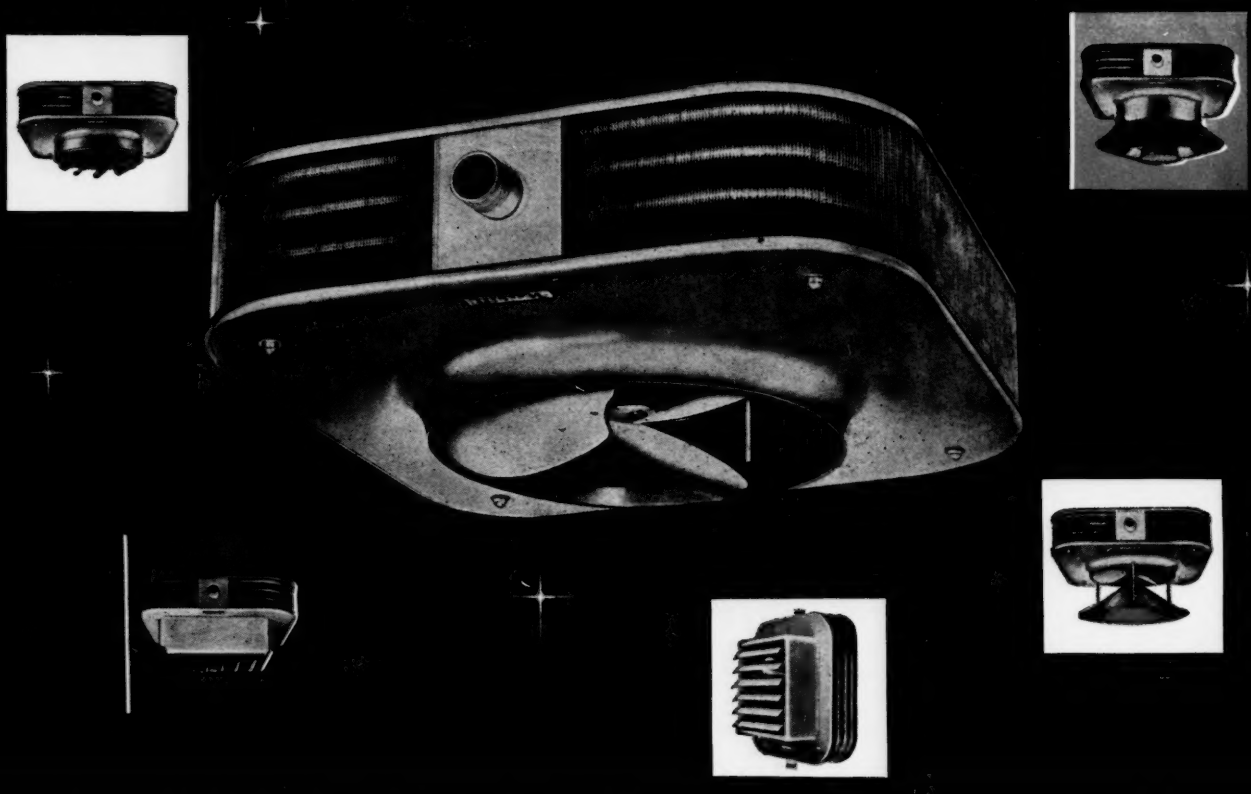

## the all new Nesbitt Little Giant unit heaters

**One heating element** operates on steam or hot water in both vertical and horizontal applications. Wrap-around rectangular construction increases heat transfer area. Opposing headers mean shorter tubes and condensate travel, assuring more even heating on steam systems.

**Closer-to-ceiling mounting** permitted by side-located piping connections. Motor on all models is removable through botton fan outlet, eliminating the need for access space above the unit. Maximum headroom is assured.

**Wide variety of outlets** (Adjustable Vane, Cone Deflector, Anemostats and Horizontal- or Vertical-Louvred) simplifies selection of the discharge patterns and mounting heights best suited to the job requirements.

**Larger capacity range** (34,000 to 684,000 Btu per hour) and smaller physical size permit the economical use of these "propeller fan unit heaters with blower fan performance" in all types of industrial and commercial buildings.

**IUHA Rated for Sound and Capacity.** All 34 models are sound rated according to today's most reliable basis for judging sound emission. You may now select Little Giants sound coded for the environment they serve.

Little Giant Unit Heaters are tested and rated in accordance with the Standard Test Codes adopted jointly by the Industrial Unit Heater Association and the American Society of Heating and Air Conditioning Engineers.

**Send today for Nesbitt Publication 402.**

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**Nesbitt**
**LITTLE GIANT UNIT HEATERS**

# AIR CONDITIONING HEATING AND VENTILATING

MAY, 1956

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**The Cover:** One of three Westinghouse heat pumps in a system designed by Kammerman & Giegerich, Inc., of Atlantic City, N. J., for a new super drug store building. See page 89.

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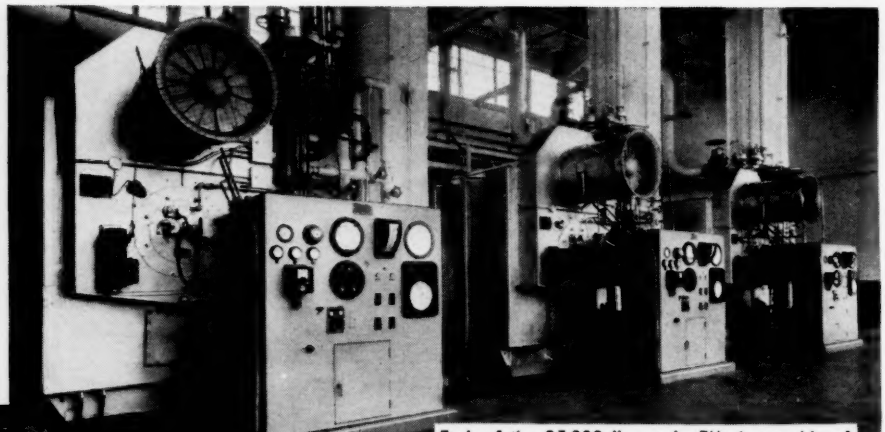


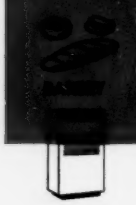
Each of the 25,000 lb per hr FMs is capable of supplying the average steam needs of the hospital. The boilers burn Bunker "C" oil to generate steam at 125 psi which is reduced to lower pressures for various hospital uses. The FM units are fully automatic and require minimum supervision and maintenance.

*cutting steam costs . . .*

**For all steam needs**

# NEW JERSEY STATE HOSPITAL

**depends on 3 B&W FM Boilers**



AIR CONDITIONING

HEAT

HOT WATER

STERILIZERS

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LAUNDRY

Three B&W Integral-Furnace Boilers are used to assure the reliable steam source required by this huge new medical center at Ancora, N. J. The FMs supply steam through a 6-mile, high-pressure steam main to a coordinated system of fresh-air conditioning, heating, and ventilating, that provides the ideal environmental conditions considered essential to the recovery of patients. In addition, FM steam supplies the large laundry, kitchen, bakery, and sterilizing requirements throughout the institution's 22 major buildings. Sufficient steam capacity was engineered into the hospital plans by Charles Simkin & Sons, Inc., Engineering Contractors, to provide for possible future expansion.

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# HIGH SPOTS

● Several records were set by **construction contract awards** in March, according to Dodge reports. The total was the highest March and second highest month in history. Residential awards were up 12% and non-residential up 16% over March of last year, and the first quarter of 1956 set **all-time records** in all categories. See News department, page 148.

● **Borg-Warner and York Corp. may merge** in a plan to exchange stock and diversify interests. York shareholders will vote on reorganization in June. See News department, page 148.

● A new Frigidaire research facility (42,000 sq ft) in Dayton, Ohio, will have a **solar research section** to study sun-operated air conditioning for the home as well as an environmental section for reproducing weather conditions.

● Shipments of **baseboard radiation** in 1955 were up 37.3% over the year previous, according to IBR, who also reported gains of 13.7% for cast iron boilers and 30.4% for industrial-type finned tube radiation. The number of firms producing equipment for **summer cooling compatible with hot water heating** nearly tripled in 1955.

● The gas utility industry added 1.4 million new gas househeating installations during the 1955-56 heating season. Total at the end of 1955 was 15.4 gas heated homes. See News department, page 152.

● Warner-Lambert Cosmetics Laboratory at Lititz, Pa., will have **300 psi hot water** in 3,074 sq ft of Burgess-Manning **radiant-acoustic** ceiling to heat 24,000 sq ft of floor space. High pressure water is available from adjacent lab. Cooling feature of the ceiling will not be used in the $5 million building project.

● Program of the building owners and managers Annual Southern Conference in Memphis included a panel of experts discussing **air conditioning equipment for multi-story buildings.**

● About half the boiler equipment in all U. S. buildings is more than 15 years old, according to an Orr and Sembower survey. President Frederick H. Klein says obsolescence of boilers is one of the biggest drains on real estate income because of high fuel costs and big maintenance bills.

● Babcock and Wilcox will install an **atomic research reactor** of the swimming pool type for the Atomic Energy Commission of Brazil. Fuel will be furnished by the U. S. Atomic Energy Commission under one of the 25 bi-lateral agreements with friendly governments.

● A Long Island developer is offering 120 split-level homes at $18,500 without air conditioning or **$20,000 completely air conditioned.**

● Appalachian Coals reports that **coal provided 75.1% of the fuel energy** used by U. S. electric utility systems in the three months ending January 31, 1956, as against 70.7% in the same three months a year earlier.

# WASHINGTON OVERTONES

by LORING OVERMAN

**Taxes**—their collection, evasion, and probable future direction—were responsible for many of Washington's mid-April overtones.

Taking advantage of taxpayers' painful awareness of the **burden of filing** (and paying) the federal income tax, various tax-economy groups urged voters to get together and **do something about it.**

● Possibly the most welcome of the several suggestions came from Former Commissioner of Internal Revenue T. Coleman Andrews. After three years as top tax collector of the federal government, Mr. Andrews urged **abolition of the individual income tax.** Since retiring as Commissioner of Internal Revenue last November, Andrews has been conducting a campaign against the individual income tax.

Trouble with most discussions of taxes is that, like the weather, nobody does anything about it.

● National Association of Manufacturers proposes encouraging voters to tell Members of Congress about a **five-year tax reduction plan** which would reduce individual and corporate rates without reducing federal revenue.

For individuals, the plan calls for five successive **annual reductions** of 16% in the progressive element of each tax bracket . . . computing each reduction on the original element and not on the declining balance. This would bring the top rate down to 34.2% at the end of five years.

For corporations, the first year reduction would be 5%—followed by four annual reductions of 3% each.

NAM points out that the country's **economic growth would offset the rate reductions,** leaving the Government with more revenue at the end of the five-year period than it had at the beginning.

● US Chamber of Commerce goes a step further. While approving the NAM tax reduction plan, US Chamber urges voters to insist that their Members of Congress **implement Hoover Commission recommendations** "to save $5.5 billion annually."

● Ohio Republican Congressman Clarence Brown points out that Hoover Commission recommendations put into effect by executive action are **already saving** half a billion dollars yearly.

● Hoover reports contain 314 recommendations which would save approximately **$33 for every person** in the United States, if adopted, so proponents say. Bills to actuate 130 of them have been introduced, but little action is expected during this election year—unless voters insist.

● Also intent upon "doing something about taxes" is the Tax Foundation. Its handbook, "Fiscal Facts for 56," points out that **economy is the real key** to tax reduction. Observes the handbook:

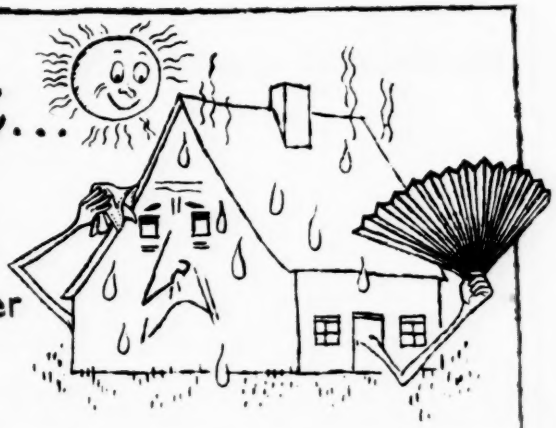
● The progressive element in the income tax structure accounts for only $5.8 billion, or **19% of the total** individual income tax bill of $31 billion. Even if rates on taxable income in excess of $10,000 were raised to 100%, additional revenue would amount to less than $5 billion—not enough to run the Government one month at present spending rates.

Meanwhile, all the present Congress has done about taxes directly is to **extend corporate income taxes** at present 52% "Korean wartime emergency rates" for another year, and to **renew tax levies** which had been scheduled to expire on April 1.

Meanwhile (again unless voters protest) spending proposals for 1957 are **up $1.6 billion** to $65.9 billion for fiscal 1957. (*Continued on page* 8)

# It's Not Only The Heat...

it's also the **HUMIDITY** which causes distress and discomfort to people; wreaks havoc on timber paint, steel and masonry.



Can summer *heat intrusion* and property damage caused by moisture, be inexpensively minimized?

Natural coolness on summer mornings, or air-conditioning, often creates lower vapor pressure in building spaces, because colder air can hold less vapor in suspension without *condensing* than can warmer air. When the air *outside* is warmer and more densely vapor-laden, there is an inward flow of vapor to the *inside;* because vapor flows from areas of greater density to areas of less vapor density. Much of this vapor may condense inside colder building spaces.

*Condensation is a destroyer!* It stimulates the fungus growth in wood which causes dry rot. It fosters insects; promotes peeling paint, rusting of iron and steel, crumbling mortar and masonry, and HUMAN DISCOMFORT.

### THE LAW OF VAPOR

Heat flow outward in *winter* ALSO causes discomfort, and increases fuel bills. But in addition, there is considerable vapor flow outward. Because warm air can hold more vapor in suspension than can cold air, and because there are many vapor-producing sources inside buildings in winter, vapor pressures build up indoors. There is a flow of vapor into the building spaces, because the cold air in them has less vapor density. There follows condensation in these cold building spaces, and DAMAGE. Moreover, with *each* pound of such vapor flow there is a LATENT heat loss of 1060 Btu's.

152 lbs. of vapor (condensing into 76 quarts of actual water) are created each week in the average home of 4 people by breathing, perspiring, cooking, laundering, bathing, mopping.

In addition, 96 lbs. of water vapor per DAY may be given off by 1000 sq. ft. of soil under a building, particularly in crawl spaces. If this vapor is permitted to migrate into the building, it can condense into 48 quarts of water and cause considerable damage.

### SCIENTIFIC BARRIER TO HEAT AND VAPOR

To interpose a summer-and-winter barrier to heat and vapor flow, the use of scientific multiple aluminum is suggested for ceiling and wall spaces, and also for ground floor spaces.

Its surfaces have a heat ray reflectivity of 97%; absorptivity and emissivity of only 3%. In addition to reflecting heat by Radiation, which represents 50% to 93% of all heat transferred through building spaces depending on direction of heat-flow, the layers of aluminum and fiber retard convection, or movement of warm air. The alternating air spaces have low density, therefore Conduction through them is slight. The aluminum sheets, long and continuous, are almost impervious to water vapor. Infiltration under the flat, stapled flanges is slight.

Condensation on or within this type of insulation is minimized by scientific, multiple layers of aluminum, fiber and air spaces.

The factors which control moisture condensation in walls and means of preventing it are interestingly discussed in an informative brochure published by the National Bureau of Standards: "Report BMS63, Moisture Condensation in Building Walls." Get a copy at our expense; just fill out the coupon.

***INFRA INSULATIONS CAN BE PURCHASED from 3¢ to 12¢ per sq. ft. depending on the type.***

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525 Bway., N.Y.C., Dept. V-5
Please send Bureau of Standards Booklet BMS 63

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## WASHINGTON OVERTONES (*Continued from page 6*)

● Opponents of the increases concede that some of the proposed new expenditures are **unquestionably necessary**—such as for military public works outlays for guided missile sites, air attack warning system, etc. Many others, they contend, are in direct conflict with Hoover Commission recommendations.

● Holding 1957 expenditures to present levels, they figure, would require a reduction of only 2½% of the estimated total.

Best news on the tax front is the **long range business outlook.** Barring our becoming involved in a war, economists see nothing pessimistic on the business horizon.

● First quarter total of **goods and services produced** was at the rate of $399 billion annually—leaving little doubt that a total of $400 billion for the year will be attained with ease. Figuring income taxes on that total—even at the reduced rates proposed by NAM—would continue Uncle Sam's income while at the same time reducing the tax burden of his nieces and nephews.

Lest the current upturn in business activity develop into a boom, Washington has again tightened up on bank credit. Federal Reserve Board has **increased the discount rate**—the rate paid by banks when they borrow from the Federal Reserve system—to discourage banks from seeking additional money to loan.

Washington is not unanimous in the thought that credit brakes should be applied to the economy.

● Alabama's Albert Rains, chairman of the Housing Subcommittee of the House Banking Committee, is alarmed at the slump in housing starts. "In March," he said, "they rose less than seasonally, to an annual rate of 1,140,000 units."

● Housing starts would have to step up to a pace of 1.4 to 1.5 million units later this year in order to reach the predicted (by FHA's Administrator Cole) 1.3 million for 1956.

Meanwhile, another great force, the tiny atom, is making its overtones felt in Washington.

● On the one hand, industry is clamoring for access permits to employ the **atom for peaceful purposes;** the Atomic Energy Commission is seeking $295.5 million for additional facilities; Navy has announced that its next **supercarriers will be nuclear-powered,** and the Air Force is to construct a nuclear reactor at Dayton, Ohio, to test materials and components under development for **nuclear-powered aircraft.**

● At the other extreme, three agencies are preparing "Operation Alert"—third of a series of annual exercises designed to **test the civil defenses** of the United States. The exercises will be staged July 20-26 by the Office of Defense Mobilization, Defense Department, and Federal Civil Defense Administration.

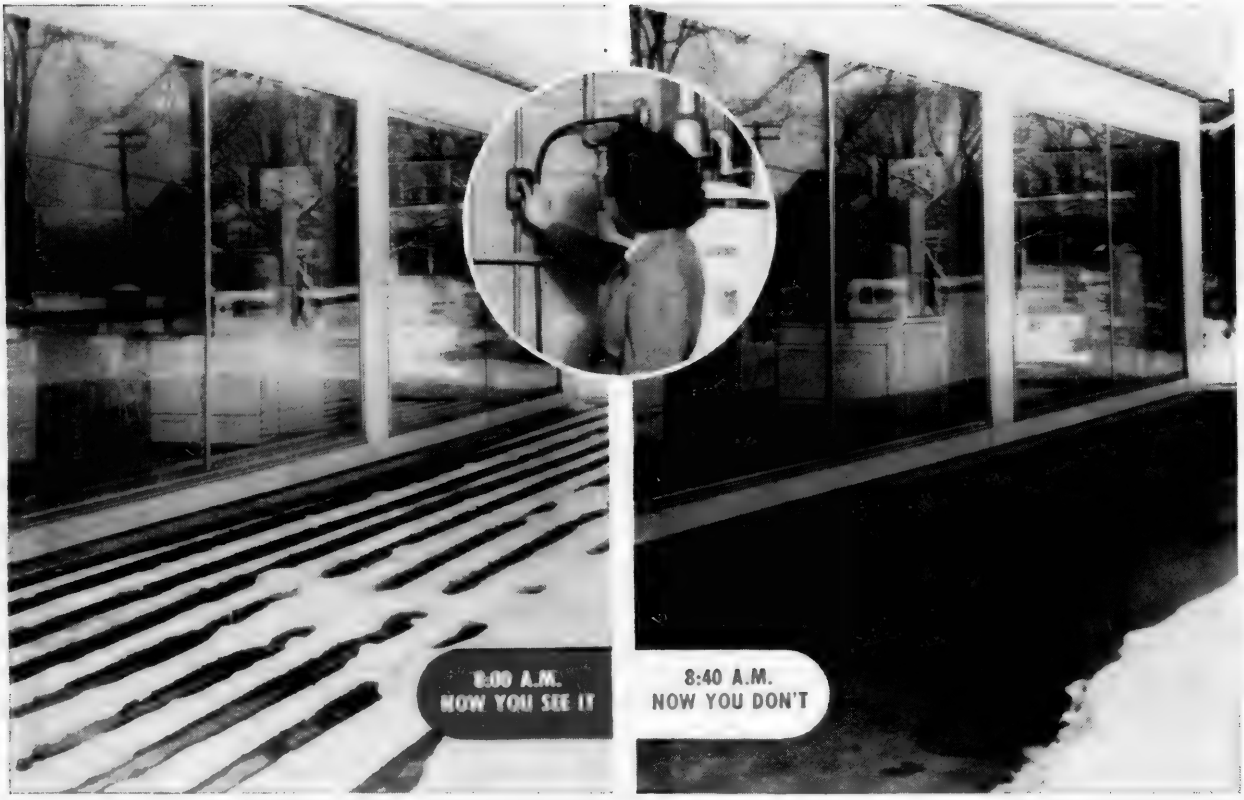
In theory, 76 areas of continental United States, its possessions and territories, will be subject to a **nuclear attack** in a five-hour period. Electrical computers, working with tapes prepared far in advance of the test, will estimate the number of casualties, extent of the damage, and the ability of the nation to continue defense and production for survival.

Air conditioning, heating and ventilating folks interested in **copper, aluminum and nickel** will welcome recent observations by Defense Mobilization Director Arthur S. Flemming.

● Mobilizer Flemming told Congress that an **action program** to encourage nickel production in Cuba is nearing completion; that copper production should increase about 30,000 to 35,000 tons a year for several years and that expansion of aluminum facilities should give the nation an annual production capacity of 2,200,000 tons very soon.

Not so encouraging is the prediction that steel prices will rise $8 to $10 a ton this year, reflecting wage increases.

Crude Oil prices may also rise before long. Talk is of an increase of 35 cents a barrel—to $3.25 for East Texas crude. Petroleum products would follow—gasoline by a cent a gallon; fuel oil next Fall when demand rises.




# 8-year old WROUGHT IRON PIPE SNOW MELTING SYSTEM still performing WINTER MAGIC

Giving winter snows the "hot foot" is an old story for The Protane Corporation, Erie, Pa.

Their snow melting system dates back to 1947 when a network of wrought iron pipe grids, 12-feet wide and 51-feet long, was installed under the sidewalk in front of their LP-Gas service building.

How efficiently the system has worked since installation is shown in the above photographs which were taken after a four-inch snowfall. The picture at the left illustrates the melting in process. Here, a hot water and antifreeze solution, flowing through the embedded pipes, is clearing the snow. Note that there is no run-off water. The snow melts, and quickly evaporates. In the picture at the right, taken 40 minutes later, all the snow has disappeared and the sidewalk is virtually free of moisture.

Starting the system is a simple matter. A push of a single button (see insert photo above) activates a high velocity pump and hot water is circulated through the wrought iron pipe system.

The Protane Corporation is gratified with the efficiency of this automatic "winter magic." But the real record, as far as they're concerned, is the trouble-free operation. "Eight years without maintenance, and the system is still going strong," is their report.

There are good reasons for the dependable, trouble-free service of wrought iron pipe in snow melting systems. You'll find complete information on why wrought iron lasts long, at lower cost per year, in our bulletin, *Byers Wrought Iron Pipe for Snow Melting Systems.* Write for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N. Y.
*Available in Canada and throughout the world.*

## BEST FOR SNOW MELTING BECAUSE...

It resists corrosion longer . . . it provides high heat transmission . . . it expands and contracts at virtually the same rate as concrete . . . it forms and welds easily on the job . . . it bends true, without springback . . . it assures sound welds and sharp, full depth threads . . . it withstands installation damage. No doubt about it . . . the advantages of wrought iron pipe for snow melting systems *start with installation* and *continue in service.*

# BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

**WROUGHT IRON**

**TUBULAR AND HOT ROLLED PRODUCTS**

**ELECTRIC FURNACE QUALITY STEEL PRODUCTS**

# BRIEFLY STATED

• The Cleaver-Brooks Co., Milwaukee, Wis., announces the appointment of Robert E. Sullivan as a supervisor of a newly formed sales department handling the sale of commercial heating boilers. Mr. Sullivan has been associated since 1952 with the Mt. Hawley Mfg. Co., Peoria, Ill., as vice president in charge of sales. Prior to that, he spent five years in sales promotion with the heating division of The Crane Co. at Boston and Chicago.

• George C. Rodgers has been named manager of the Engine and Compressor Department of American Air Filter Co., Inc., succeeding the late Charles Sowerby who died last year. In addition to his new duties, Mr. Rodgers will continue as manager of Military Products. He has been with the Herman Nelson Division of the company for the past five years. Prior to being named manager of Military Products, he was manager of Special Products. For five years prior to joining the company, Mr. Rodgers was a representative for the Society of Automotive Engineers at the Bureau of Standards in Washington. During the preceeding fifteen years he was employed by the Curtiss-Wright Corporation as a development engineer and as manager of its electronic and rocket propulsion division.

• Robert C. White has been named chief product specialist for Carrier Corporation's Machinery and Systems Division, it was announced by Charles V. Fenn, vice president. He will make his office at the company's Syracuse, N. Y., executive headquarters. Prior to receiving his new appointment, Mr. White was senior sales engineer in the division's Chicago district office. During the nearly two decades he has been with Carrier, he has actively participated in selling unitary equipment as well as complete systems for large commercial and industrial applications.

• At a meeting of the board of directors of Carrier Corp., held in New York City, Cloud Wampler was elected chairman of the board and in that capacity will continue as the chief executive officer. William Bynum, executive vice president since 1951, was elected president to succeed Mr. Wampler and will be in charge of operations.

• C. Richard Sword has been appointed manager of sales of Aerovent Fan Co., Inc., Piqua, Ohio, replacing James F. Tilton, who resigned, according to an announcement by Martin W. Bauer, vice-president and general manager. Mr. Sword, who joined the company in 1951, has served as assistant manager of sales since 1952.

• The Swartwout Co., Cleveland, Ohio, has announced the sale of its power plant equipment division to Republic Flow Meters Co., Chicago, Ill. Amount involved in the transaction was not disclosed. Republic is establishing a Swartwout Division to carry on engineering, manufacture, sales and service of Swartwout's line of steam specialties.

• Shareholders of Rheem Mfg. Co. and Richmond Radiator Co. have voted to merge. The merger, which became effective upon the completion of procedural requirements, called for the exchange of four shares of Richmond common stock for one of Rheem. Under the agreement John J. Hall, president of Richmond, will become a vice president of Rheem in charge of a separate Richmond division.

• Construction has been started on a new air conditioned manufacturing plant for Kennard Corp., St. Louis, Mo. The new plant will be located in St. Louis County and will be approximately double the size of the present one. The company's entire manufacturing operation will be moved into the new plant. The exact completion date is not set, but full production is expected by the end of the year.

• A. William Fraser and Clarence S. Wentworth have been appointed commercial vice presidents of Worthington Corporation by the board of directors, Edwin J. Schwanhausser, president, announced recently. Mr. Fraser has been Midwest regional sales manager since 1951 and is in charge of the district sales offices at Chicago, Denver, Kansas City, St. Louis, and Minneapolis. His headquarters are at Chicago. Mr. Wentworth is sales manager of the central region, with headquarters at Cleveland, and is responsible for the district sales offices at Buffalo, Cincinnati, Cleveland, Detroit, and Pittsburgh.

• At a testimonial dinner tendered to Dr. Edward R. Weidlein yesterday by the Members of Mellon Institute, at the Schenley Park Hotel, Pittsburgh, Pa., an announcement was made of his retirement. Dr. Weidlein has been actively identified with the Institute for over forty years, serving as a senior fellow, 1912-1916, and then as an executive staff member from 1916 to 1951, when he was made president of the scientific research organization. He will remain on the Board of Trustees of the Institute in an advisory capacity for the Institute's research programs.

• Robert B. Taggart, formerly acting manager of the Dudco Division of The New York Air Brake Company, has been appointed manager of manufacturing at the company's Aurora Pump Division, Aurora, Ill. A graduate industrial engineer from Yale University, Mr. Taggart joined the company in 1953. He has more than 27 years of experience in manufacturing gear drives, transmissions, fluid motors, pumps, and pneumatic controls.

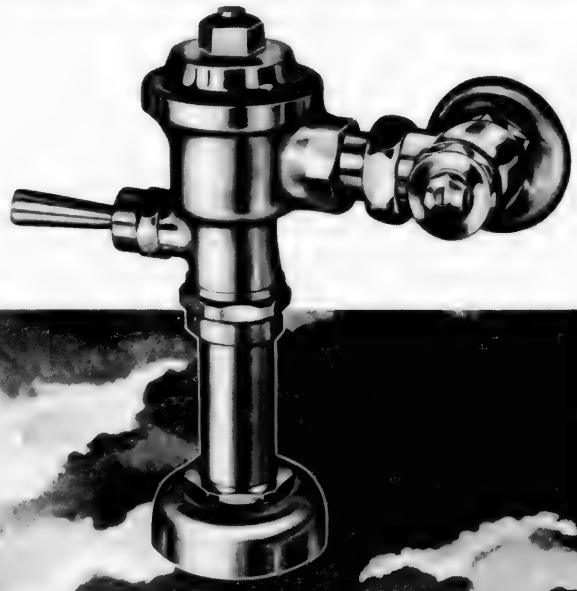
• The election of Edward H. Petersen as treasurer of Crane Co., by the company's board of directors, is announced by Frank F. Elliott, president. He succeeds H. H. Bunchman, who is on leave of absence. Petersen joined Crane as a member of the comptroller's staff in 1936 and in 1938 was made auditor in charge of general accounting at the firm's general offiices in Chicago. He became an analyst in the finance division in 1950, and has been assistant treasurer of the company since April, 1953. He is a member of the Illinois State Chamber of Commerce and the Illinois Society of Certified Public Accountants.

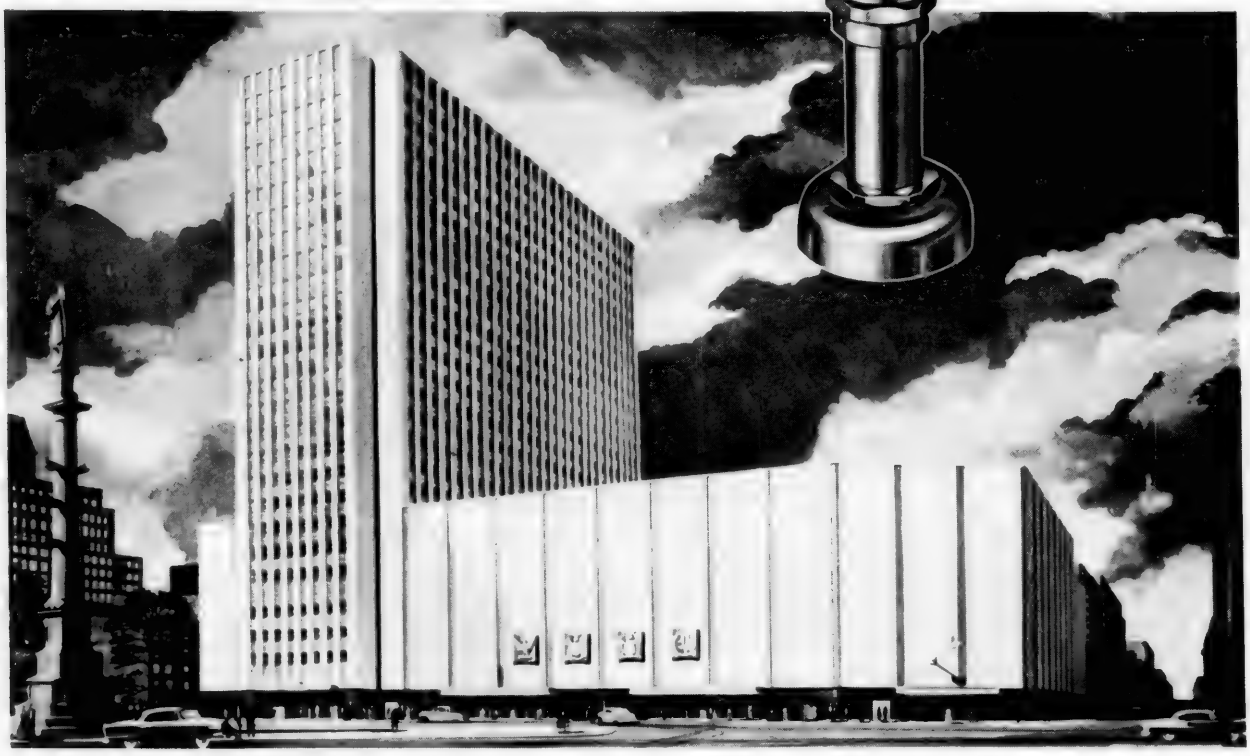
• Hobart C. Ramsey, chairman of Worthington Corporation, and Eldon Macleod, president of the Mason-Neilan Regulator Company, Boston, Mass., announced an agreement for the transfer of the net assets, name and goodwill of Mason-Neilan to Worthington in exchange for Worthington common stock. Mr. Ramsey stated that the Mason-Neilan plant and facilities would be operated as the Mason-Neilan Division of Worthington, and that the entire working force and management staff will be continued in their present positions.

(*Continued on page* 12)

# *And in New York* – A FUTURE OF FAULTLESS SERVICE

**NEW YORK COLISEUM**
*New York, N. Y.*
**TRIBOROUGH BRIDGE & TUNNEL AUTHORITY**
*owner*
**LEON and LIONEL LEVY**
*architects*
**GUY B. PANERO**
*mechanical engineer*
**ASTROVE PLUMBING & HEATING CORP.**
*plumbing contractor*
**SMOLKA CO., INC.**
*wholesale distributor*
**RICHMOND RADIATOR CO.**
*plumbing fixtures manufacturer*





Bidding for high ranking as a leading convention center is the mammoth $35,000,000 New York Coliseum—another COYNE & DELANY installation now under completion in the heart of Manhattan. Beneath the massive bulk of the four level exhibition hall lies an 850 car garage, while, rising above, a 20 story office tower will bring usable floor space to a total of 1,000,000 square feet. Called one of the most distinctive buildings ever conceived, the Coliseum has a lobby one and a half city blocks in length, is air conditioned throughout, and contains battery after battery of COYNE & DELANY diaphragm type flush valves—over 600 in all. It is significant that here, where flush valves must provide unflagging service under the heaviest usage, specifications included DELANY—
"the fastest growing name in flush valves!"

*This new "HAND BOOK and CATALOG No. 53" is the most comprehensive of its kind—designed for everyday reference . . . 19 pages of installation details for exposed, concealed and special FLUSH VALVE installations . . . over 75 blue prints . . . cut away views . . . many pages of charts, formulae, piping details . . . sent free, if requested on firm letterhead.*

**COYNE & DELANY CO. • 834 KENT AVE. • BROOKLYN, NEW YORK**
IN CANADA: THE JAMES ROBERTSON CO., LTD.

**DELANY *Flush* VALVES** *Since 1879*

## BRIEFLY STATED

(*Continued from page* 10)

• At the Annual Meeting of the Convector Manufacturers Association, held recently at the Hotel Statler in Detroit, the following officers were elected for the ensuing year: J. M. Whalen, president, R. S. Rickabaugh, vice-president, and R. E. O'Rourke, secretary-treasurer. Mr. Whalen is convector sales manager of The Trane Co. Mr. Rickabaugh is the heating products division sales manager of the Tuttle & Bailey, Inc.

• R. E. Lucey, Trane vice president and manager of engineering, has announced the promotion of three senior development engineers in the company's products engineering department to positions of chief engineer. The men, R. G. Miner, Jr., E. T. Neubauer, and A. M. G. Moody, will assume added responsibilities in their respective fields by heading the controls and electrical, recpirocating compressor, and centrifugal compressor phases of the company's product development program.

• Airtemp Div., Chrysler Corp., announced the promotion of J. C. Davidson to the post of assistant sales manager of residential heating and cooling. The post has been newly created as a part of the company's enlarged residential sales program. Manager of the company's application-engineering department for the past two years, Mr. Davidson has been associated with the division since 1947.

• Henry E. Little has been appointed general superintendent in charge of operations at the Cleaver-Brooks plant now under construction in Lebanon, Pa. Mr. Little was formerly chief engineer and assistant superintendent of the fabricating and stamping divisions of Phoenix Iron and Steel Co., Harrisburg, Pa. The new Lebanon plant will serve as the Eastern branch assembly plant.

• The National Power Show will return to New York after a four-year absence. Officially known as the 22nd National Exposition of Power and Mechanical Engineering, the display is scheduled for November 26-30 under auspices of the ASME in conjunction with the Society's 76th annual meeting. As heretofore, it will be under management of the International Exposition Co. and will be held in the recently completed New York Coliseum.

• Clifford B. Woodward, Jr., has been appointed manager of commercial engineering of General Electric Co., Weathertron Dept., Bloomfield, N. J. As manager of commercial engineering, Mr. Woodward will be responsible for application engineering, application training, product service, and parts sales. Mr. Woodward joined the air conditioning division of the company in 1950.

• James P. Wiseman, president of Fluor Products Co., Whittier, Calif., has been elected president of the Cooling Tower Institute for 1956. The outgoing president is Neal B. LauBach of Hudson Engineering Corp., Houston, Tex. Other officers elected for 1956 terms are Forrest B. Reed of The Marley Co., Kansas City, Mo., vice-president; Karl E. Johnson of J. F. Pritchard & Co. of California, Kansas City Mo., secretary; and Denis E. O'Neil of Foster Wheeler Corp., San Mateo, Calif., treasurer.

• John F. Corcoran has been promoted to general manager of the Union Asbestos & Rubber Company's equipment steel products, equipment specialties, coldmobile and hand brake divisions, and Emil T. Johnson has been named general manager of the fibrous products division. Both vice presidents, Mr. Corcoran and Mr. Johnson joined the company in 1952 and 1947, respectively.

• Several executive appointments announced by The Mercoid Corporation are: Willis E. Jones as sales manager and Paul J. Provost as manager of the company's industrial controls division. G. R. Folds, Jr., is being recalled to Chicago from the West Coast to work with Mr. Provost.

• L. S. Wilcoxson, vice president of The Babcock & Wilcox Company, was elected to the board of directors of the company at the annual stockholders meeting held recently. In addition to his duties as a director, Mr. Wilcoxson will continue to be in charge of the company's boiler division.

• Milton S. Smith, vice president and treasurer of Buensod-Stacey, Inc., has been elected president and chief executive officer of the company. Mr. Smith, who twenty years ago was one of the founders of the company, succeeds A. C. Buensod, also a founder of the company and president since its organization, who has been elected chairman of the board. R. O. McGary, also a founder, has been elected senior vice president in charge of sales.

• The Trane Company has awarded contracts for the construction of a 65,000 sq ft office building. The cost of the building and equipment has been estimated to be $1,250,000 by Albert Kahn, Associated Architects & Engineers, Inc., consultants.

• W. E. Landmesser has been named manager of sales for residential and commercial air conditioning products of York Corporation. This is a new position created as part of the commercial division sales department.

• John R. Lenox has been appointed general manager of Minneapolis-Honeywell Regulator Company's appliance controls division at Gardena, Cal. Mr. Lenox was director of ordnance and transistor divisions. He is succeeded in that position by Clyde A. Parton, formerly director of engineering for the firm's aeronautical division. Raymond S. Fries, formerly manager of new products in Minneapolis, has been transferred to the California plant with Mr. Lenox to become factory manager.

• Hermann C. Hoffman has been named general sales manager of Carrier Corporation's machinery and systems division. Mr. Hoffmann will have general responsibility for sales of large air conditioning and refrigeration equipment.

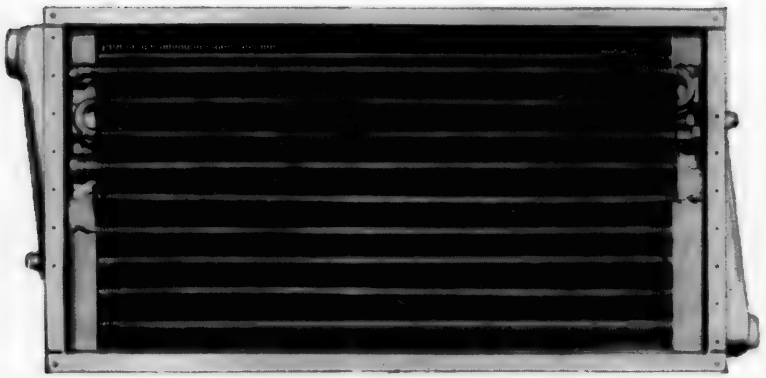
• J. Frederic Byers, Jr., formerly executive vice president, has been elected president of the A. M. Byers Company, Pittsburgh, Pa. He succeeds A. B. Drastrup, who resigned as president and director to accept an executive position with another company. Mr. Byers has been with the company since 1937, serving in various sales, administrative, and executive capacities. He is a grandson of A. M. Byers, the founder of the 92-year-old company, and son of the late J. Frederic Byers, Sr., chairman of the company at the time of his death in 1949.

We Make

*Extended-Surface*

**HEAT EXCHANGERS**

*Exclusively!*



The pioneer in the field, Aerofin has concentrated on one thing, *and one thing only* — highly efficient, easily installed, easily maintained extended-surface heat exchangers. Aerofin's design, research, engineering and production experience and facilities are unequalled anywhere.

***For High Efficiency, Easy Installation, Low Maintenance and Servicing Costs . . .***

*Aerofin is sold only by manufacturers of fan system apparatus. List on request.*

AEROFIN CORPORATION

*101 Greenway Ave.*
*SYRACUSE, N. Y.*

# Office Building

THE NEW ENGLAND LIFE BUILDING, Boston, Massachusetts. Architects: Cram & Ferguson; Engineers: Buerkel & Company. ELECTRO-MATIC filters supply 200,000 cfm of super-clean air on nine air conditioning systems.

# Saves $16,000 a Year

## with *Electro*-MATIC filters!

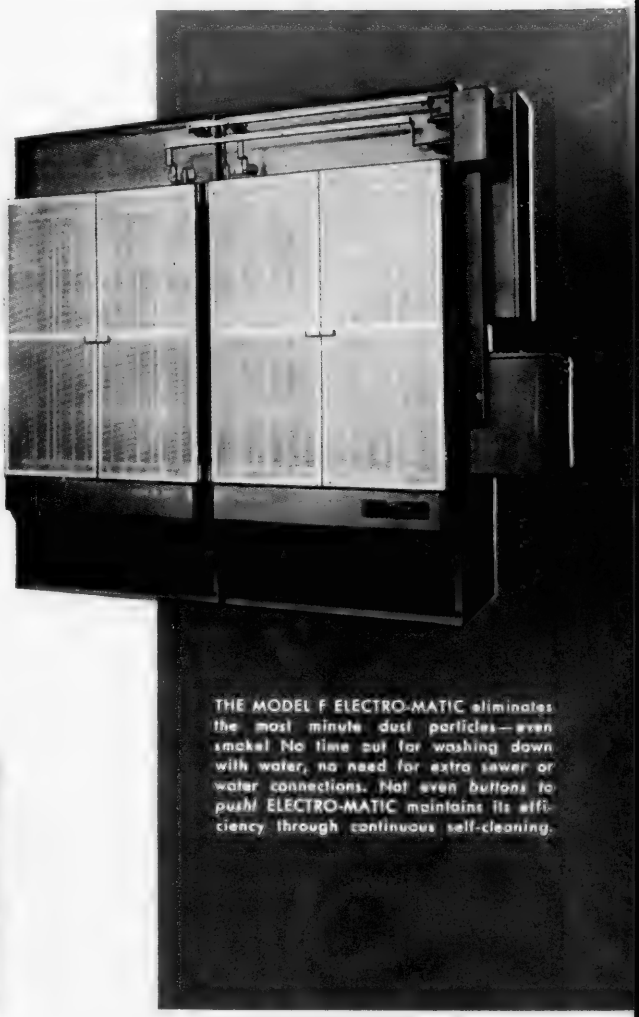
### New England Life Building gets SUPER-CLEAN Air at a saving

IN 1941, when the New England Life Insurance Company moved into its beautiful new building, *mechanical* filters were installed to supply 200,000 cfm of clean air for nine air conditioning systems.

Six years later, these filters were replaced with AAF ELECTRO-MATICS. Results: *super-clean* air allowed a *20% reduction* in the cleaning staff. The ELECTRO-MATICS have long since paid for themselves and are now saving the Company $16,000 *every year* they are in operation!

And maintenance is remarkably simple. One man spends *less than 8 hours a week* maintaining filters on all nine systems. That's because ELECTRO-MATIC has its own built-in "maintenance crew"—cleans *itself* continually, *while it's cleaning the air!*

Super-clean air at a saving—that's "the New England Life ELECTRO-MATIC Story" in a nutshell. *Now*—get the *whole* story. Write for free 12-page booklet that provides complete data on ELECTRO-MATIC's money-saving performance.



THE MODEL F ELECTRO-MATIC eliminates the most minute dust particles—even smoke! No time out for washing down with water, no need for extra sewer or water connections. Not even *buttons to push!* ELECTRO-MATIC maintains its efficiency through continuous self-cleaning.

AAF

herman nelson

**American Air Filter**
COMPANY, INC.
294 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

AAF Dust Control Equipment

Illinois Steam Heating Specialties

BETTER AIR IS OUR BUSINESS

Herman Nelson Unit Heaters

Herman Nelson Unit Ventilators

# Giant Snow Melting System for Staten Island Ferry Building features "*snowless*" stairway

**Snow melting coils in place on stairway forms ... and freshly concreted stairway. Handrails to be installed later.**

Reconstruction of the Manhattan Terminal of the Staten Island Ferry, operated by New York City's Dept. of Marine and Aviation, includes an extensive snow melting system. The long curving ramp, which starts at street level and expands into a semi-circular walkway on the second level, is completely fitted with snow-melting coils, as are the walkways.

A unique feature of the installation is that an open stairway from the street to the top of the ramp has also been equipped with snow-melting coils—one length of 1" pipe in the tread of each step.

Approximately 14 tons of 1" NATIONAL Steel Pipe were used in the grids, and about 5 tons of sizes up to 3" were employed as headers, connecting pipes, etc.

Architects, engineers, and contractors have been specifying USS NATIONAL Steel Pipe for over 60 years as the "standard" choice for conventional plumbing and heating systems.

The inherent characteristics of NATIONAL Pipe are well known—smooth, uniform bending; sound, strong welding properties, and extra-long service life—characteristics that make NATIONAL Pipe ideal for such applications as snow melting and radiant heating, and give it the reputation for dependability that it enjoys. Such a well-deserved reputation inspires confidence—a nation-wide confidence that has made USS NATIONAL Pipe the largest selling pipe in the world. Write for free descriptive literature.

**NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.**
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

**USS NATIONAL PIPE**

**UNITED STATES STEEL**

*America's most beautiful gas unit heater...*

the *Magnificent*

# Modine

**a new concept in styling and performance sets pace in gas-fired unit heating**

# *Beautiful*... to be sure! But there's more to the new Modine than meets the eye

Here at last is a gas unit heater so strikingly beautiful it can be installed with pride in the finest commercial, institutional and industrial buildings. Truly distinctive lines and attractive soft green finish are accented by sparkling medallion, grilles and panel of polished chrome. Yes, the new Modines are in a class by themselves — thanks to the skill of famous designer Jean Otis Reinecke.

And the new Modines are as great as they look . . . in performance, economy and safe, trouble-free operation. Check these unmatched benefits:

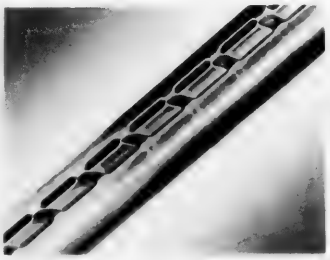
**New performance** — Improved stainless steel burners and choice of stainless or aluminized steel heat exchangers, with combustion air inlets located directly below, increase heating efficiency, minimize corrosion.

**Quieter operation** — Lower speed motors, new fan design and resilient motor mounting assure quieter operation at full-capacity heat delivery . . . provide ample heat throw to all areas without hot blasts.

**Lighter weight** — Actual comparisons show the new Modines to be *up to 50% lighter* than other makes. They are easier to install, cost less to ship and handle.

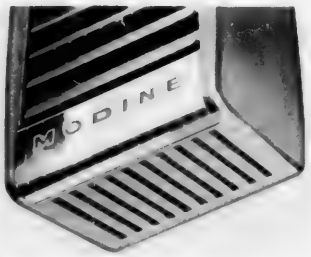
**Wider range of sizes** — The new Modines are available in eight sizes now, ranging from 25,000 to 310,000 Btu. There's a size for every application of natural, manufactured, mixed, LP and LP-air gases.

For full particulars, see your nearest wholesaler or the Modine representative listed in your phone book. Wholesaler franchises still open in some areas.



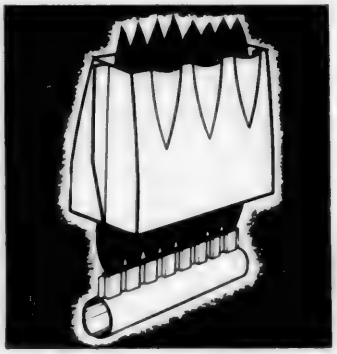
**SELF-CLEANING PORTS**

Knife-sharp stainless steel ports have four times the free area of drilled ports. Keen edges resist lodging of dirt and scale, maintain uniform flame.



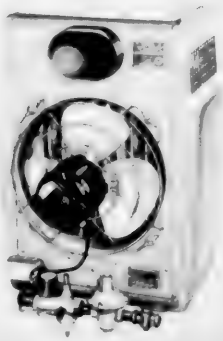

**IMPROVED COMBUSTION**

Hooded combustion air inlets directly below each tube assure higher burning efficiency, minimize flame disturbance.



**FASTER, MORE UNIFORM HEAT**

Continuous, uniform flame from front to rear of individually and directly-fired tubes boosts radiant heat absorption and uniform heat distribution.



**SAFETY MEASURE**

Sturdy guard protects against hazards of exposed fan and provides resilient suspension for motor and fan assembly, further reducing vibration noises.

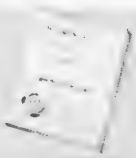
**BIG SIZES, SMALL PACKAGES**

This 25,000-Btu Modine gas unit heater weighs only 35 lbs. New Modines are ideal for factories, offices, laboratories, washrooms, garages, service stations, stores.

**CLIP THIS COUPON AND MAIL TODAY**

**MODINE MFG. CO.**
**1500 DeKoven Ave., Racine, Wis.**

Please send me immediately a free copy of new bulletin, "The Magnificent Modine Gas-Fired Unit Heater."



Name .....

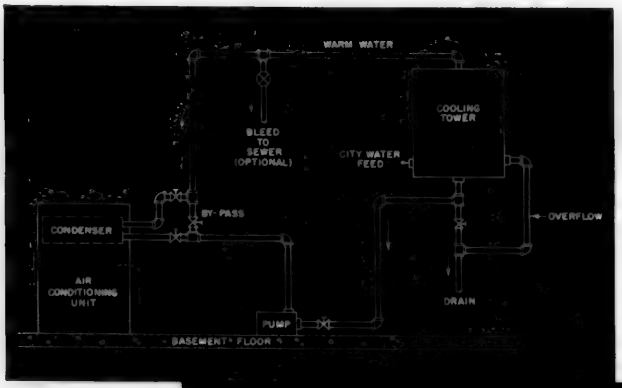
Firm .....

Address .....

City .....Zone .....State .....

G. U. 1306

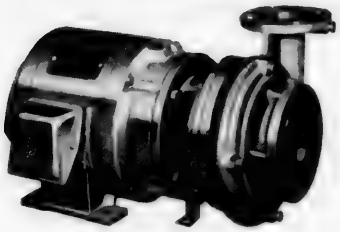
***Modine***
**GAS UNIT HEATERS**




# QUIETER PUMPS

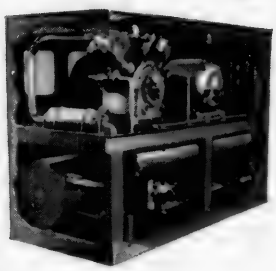
## FOR COOLING TOWER APPLICATIONS

**B&G 1522 CENTRIFUGAL PUMPS**



### B&G SERIES 1531-B CENTRIFUGAL PUMPS

Equipped with self-lubricating, leak-proof "Remite" Seal. Superfinished shaft oversized for minimum deflection. Impeller is of sound hydraulic design, with balancing ring and relief holes to reduce thrust. Heavy duty ball bearing motor. Capacities to 1200 GPM, heads to 420 ft. Many sizes carried in factory stock.



### B&G PACKAGE LIQUID COOLER

A complete cooling unit for homes, apartments, commercial and industrial buildings. Low pressure drop through evaporator—non-recycling pump down—integrated electrical control system—complete wiring—are a few of many outstanding features. Send for Bulletin HB-755.

Get rid of pump noise troubles in your cooling installations ...next time install a B&G 1522!

This pump is *really quiet*...because *both pump and motor* are equipped with long bronze sleeve bearings...and because of the noise-dampening flexible spring-type coupler.

The B&G 1522 offers an impressive number of other features for dependable, low-cost operation. The "Remite" Mechanical Seal, for example, ends leakage troubles. It's self-lubricating—harder than glass—wear-proof. The impeller is dynamically balanced for smooth, vibrationless operation... the entire bearing bracket assembly, including shaft and sleeve bearing, is interchangeable. Servicing is simple—the 1522 separates into three parts.

All these plus values cost no more—the B&G 1522 Pump is *competitively priced!* It is available as an all-iron, bronze-fitted, all-bronze or a stainless steel unit, with capacities to 150 GPM, heads to 115 ft. Available in common sizes from factory stock. Send for Catalog.

Send for your free copy of the B&G Six Step Manual for Designing Cooling Tower Systems.

**BELL & GOSSETT**
**COMPANY**
**Dept. REI-4, Morton Grove, Illinois**
*Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, W. Toronto*

# Bethcon bends flat without flaking

Yes, you can actually bend Bethcon double without flaking off the zinc coating. That's because Bethcon is galvanized by a continuous process which bonds the zinc to the base steel much more tightly than conventional methods.

This is one of the advantages of Bethcon which has caused sheet-metal contractors to call for increasing supplies of this remarkable galvanized sheet. There are other advantages, too, which will interest both you and your customers.

For instance, Bethlehem's continuous galvanizing process distributes the zinc more evenly, and eliminates the heavy beads usually found on the drip ends of hot-dipped sheets. Then, too, you can have Bethcon in coil lengths as well as cut sheets. And the smaller, brighter, more uniform spangles are bound to be far more attractive to your customer's eye.

You can specify Bethcon in any gage from 14 on up, in plain steel or copper-bearing for extra corrosion-resistance. If you have not yet worked with Bethcon, you might like to talk with someone who has. If so, we'll gladly give you the name of such a contractor who is located somewhere near you. Or if you'd prefer to discuss it with one of our own men, just get in touch with the nearest Bethlehem district sales office.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
*Export Distributor:* Bethlehem Steel Export Corporation

**BETHLEHEM STEEL**

BETHLEHEM STEEL

Practical Data on Air Distribution

Prepared by the Engineering Department of Tuttle & Bailey, New Britain, Connecticut

# Selecting the Right Equipment

As a service to those responsible for specifying air distribution equipment, Tuttle & Bailey will publish a series of technical articles on this all-important phase of heating, ventilating, and air conditioning systems. It is hoped these articles will be of help to the newcomers in the field and serve as "refresher" information for others.

Complaints arising from faulty air distribution are usually caused by drafts or stuffiness. These uncomfortable sensations are the result of one or more factors: temperature stratification, fluctuating gusts of air, warm or cold spots, or incorrect residual velocities. To obtain the correct residual velocities, and to eliminate spotty and gusty distribution, equipment first must be selected on the basis of its induction characteristics. In addition, we must know the effective area of the equipment selected.

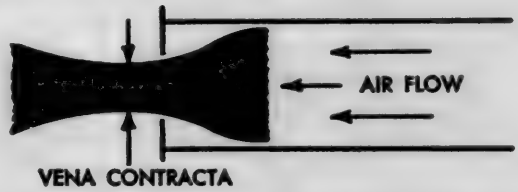
### Induction Characteristics

Induction is simply the mixing of supply air and room air above the six foot (occupied) zone, in the room. The various types of air distribution devices available differ widely in the rapidity in which induction takes place. (See table below.)

Ceiling height and type of occupancy must be considered but generally the determining factor in selecting one type of device over another should be by comparison of induction characteristics. It is accepted that the higher the CFM per sq. ft. of area to be conditioned, the higher the induction rate of the device should be.

### Effective Area

The performance of an air distribution outlet and the pressure calculations involving it are predicated upon its effective area. What this means can best be illustrated by a sharp-edge orifice located at the end of a duct. As the air approaches the orifice, it assumes a stream shape which at some point in its travel is smaller than the aperture through which it passes. This area is called the "vena contracta" — or the effective area of the orifice.




The same fact applies to an air distribution device. Air does not completely fill the passages of a diffuser — or between the bars of a grille — and at some point

| Type | Mounting | Induction |
|---|---|---|
| Rectangular or linear diffuser | On ceiling | Low |
| Straight flow grille | In sidewall at ceiling | Low |
| Straight flow grille | In sidewall below ceiling | Low |
| Side deflection grille | In sidewall at ceiling | Medium |
| Half-round ceiling diffuser | In ceiling | Medium |
| Full-round ceiling diffuser | In ceiling | High |
| Full-round ceiling diffuser | Located down from ceiling | High |

within the passages, a vena contracta exists. The sum of these vena contracta areas is the effective area of the outlet. Although the shape, size, and number of rings or bars of the device will influence the effective area and the location of the vena contracta areas, the principle applies regardless of design.

### Application of Effective Area

The most important use of the effective area of an air outlet is to predict its throw. "Throw" is the distance or radius in feet that an air stream travels from its point of discharge to a point at which its velocity falls to a predetermined value. The velocity of the stream at the selected point determines the residual velocity, or the velocity of air in the occupied zone.

For ceiling diffusers, the throw can be determined by:

$$T = \frac{K \times CFM}{\sqrt{A_e}}$$

where:
- $T$ = The distance in feet the air stream travels to a point at which its motion falls to a predetermined value
- $CFM$ = The cubic feet of air per minute
- $K$ = A constant determined by test and based on the induction characteristics of the diffuser
- $A_e$ = Effective area of the outlet in sq. ft.

**"K" Values for Diffusers Discharging 360° Circular Air Pattern**

| Terminal Velocity | Average Residual Velocity | Flush Ceiling Mounting | Exposed Mounting |
|---|---|---|---|
| 100 FPM | 25-40 FPM | .0120 | .0080 |
| 150 FPM | 40-60 FPM | .0100 | .0066 |
| 200 FPM | 60-85 FPM | .0075 | .0050 |

As with ceiling diffusers the effective area of grilles and registers must be known to predict their performance. Although ceiling diffusers usually have a fixed effective area, adjustable bar grilles and registers have an infinite number of effective areas depending upon their deflection settings.

To determine the distance an adjustable bar grille or register will throw:

$$T = \frac{K \times CFM}{\sqrt{A_e}}$$

where:
- $T$ = Throw in feet
- $K$ = A constant determined by test and based on the deflection setting of the bars
- $CFM$ = Cubic feet of air per minute
- $*A_e$ = Core area in square inches

**"K" Values for Adjustable Bar Grilles and Registers**

| Angle of Deflection | "K" Values |
|---|---|
| Straight | .80 |
| 22°-0°-22° | .68 |
| 42°-22°-0°-22°-42° | .55 |
| 55°-42°-22°-0°-22°-42°-55° | .43 |

*It should be noted that the throw formula differs from the one for ceiling diffusers in that it includes the term "core area" which relates the effective area of the grille to its catalogued size.

A terminal velocity of 50 FPM is used when selecting grilles because of their lower induction characteristic. This produces a residual velocity of 25-40 FPM.

### Conclusions:

1. Select an air distribution device with the right induction characteristic.
2. Know the effective area of the device you select.
3. Determine the right terminal and residual velocities and select the throw of the device to obtain them.

---

*This is the first in the series of these technical articles. In months to come, subjects will cover specific problems encountered in the field.*

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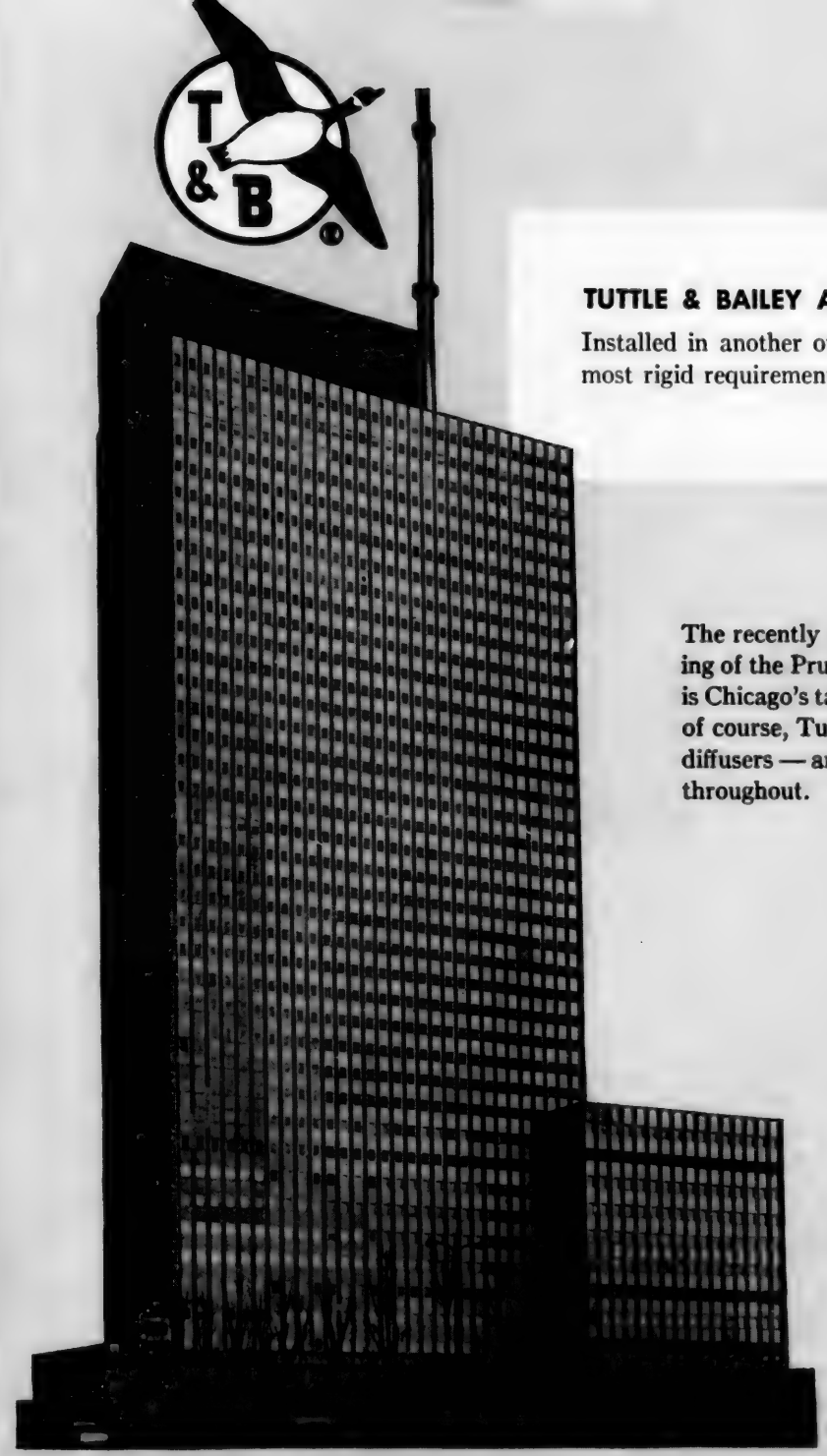
If you have a specific problem involving air distribution, Tuttle & Bailey's Engineering Department will welcome the opportunity to be of help. Address: R. D. Tutt, Chief Engineer, Tuttle & Bailey, New Britain, Connecticut.



## TUTTLE & BAILEY AIR DISTRIBUTION EQUIPMENT

Installed in another outstanding building . . . to meet the most rigid requirements of performance and appearance.

The recently completed 41-story Home Office Building of the Prudential Insurance Company of America is Chicago's tallest and most modern. Air conditioned, of course, Tuttle & Bailey circular and linear ceiling diffusers — and grilles and registers — are installed throughout.

For specific catalog information on T&B Diffusers, Grilles and Registers, or High Pressure Units, write—

**TUTTLE & BAILEY**

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A complete line
of air distribution equipment and accessories
for low and high pressure systems

another outstanding

# "HEAT PUMP" INSTALLATION

with

## JOHNSON CONTROL

**In one of the first applications of its kind, a complete heat pump system is combined with radiant panel heating and cooling as well as central fan air conditioning**

*Simms Building, Albuquerque, N. M. Flatow & Moore, architects; Bridgers & Paxton, mechanical engineers; all of Albuquerque.

Albuquerque's new Simms Building* is widely recognized as an outstanding example of modern design and high functional efficiency. Equally impressive are the building's mechanical facilities, which include a reverse cycle "heat pump" combined with a radiant panel heating and cooling system and six central fan systems for heating, cooling and ventilation.

The successful operation of this modern air conditioning installation requires a control system capable of solving a constantly varying array of intricate control problems, some of which are cited on the opposite page.

*All* of these problems and many others are solved with precision by a specially engineered system of Johnson Control. Each part of the mechanical system is controlled in perfect coordination with the others. Johnson Control provides the accuracy and flexibility to insure complete, year 'round comfort throughout the entire building. And, equally important, it gives the Simms Building the economies of virtually waste-free heating and cooling performance.

The superior comfort and economy features of Johnson Air Conditioning Control can be applied to any building, regardless of its type or size. Whether your particular problems demand this kind of intricate control system or a very simple arrangement of thermostats and valves or dampers, look to Johnson for the best solution. A nearby Johnson engineer will gladly give you his recommendations without obligation. Johnson Service Company, Milwaukee 1, Wisconsin. Direct Branch Offices in Principal Cities.

Panel mounted Johnson instruments permit easy remote observation of air and water temperatures at key points in the system. Hot and chilled water and well water temperatures are automatically recorded.

**JOHNSON CONTROL**

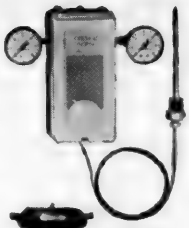
SINCE 1885

PLANNING • MANUFACTURING • INSTALLING

## RADIANT PANEL CONTROL

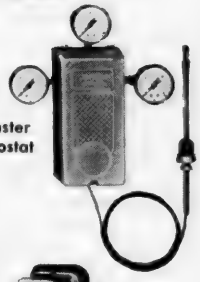
Radiant panels for heating and cooling are located above and below glass areas. Panel water temperatures on the north side are controlled by a Johnson Master Thermostat which measures the outdoor temperature. On the south, water temperatures are varied by a solar compensated Master Thermostat that measures the combined effect of outdoor temperature and solar heat gain.

The two Master Thermostats reset Submaster Thermostats controlling Johnson Three-Way Mixing Valves on the heated and chilled water supplies. Solar heat gain requires simultaneous heating and cooling, even when outdoor temperatures are below 20°F.



T-900 Master Thermostat

V-108 Three-Way Mixing Valve

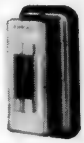


T-901 Submaster Thermostat

## FAN SYSTEM CONTROL

Air for heating, cooling and ventilation is supplied by six central fan systems which operate under the efficient direction of Johnson Controllers. Each shop and commercial space on the main floor is a separate zone, while the balance of the building is zoned by floors and exposure.

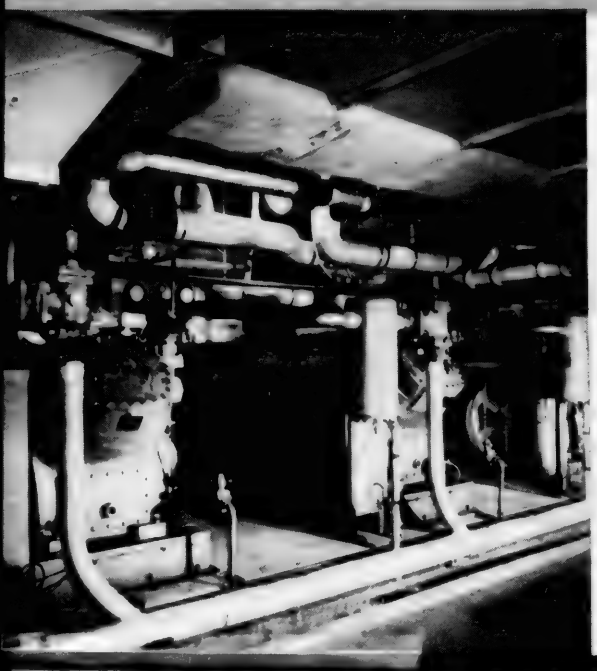
Strategically located Johnson Room Thermostats, controlling Mixing Dampers on the hot and cold plenums of the units, insure constant supplies of perfectly conditioned air throughout each zone. Fan systems are also controlled to permit some areas to be heated at the same time others are being cooled. Static Pressure Regulators maintain a 0" differential between hot and cold plenums of the units.



T-400 Room Thermostat

D-251 Piston Damper Operator

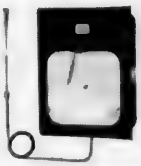
R-302 Static Pressure Regulator



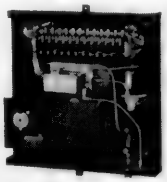
## "HEAT PUMP" CONTROL

A Johnson Recorder-Controller determines the overall demand for heating and cooling in accordance with outdoor temperatures and, acting through Submaster Thermostats, Limit Thermostats and Johnson Valves, controls the primary supplies and temperatures of heated and chilled water for the panels and fan systems.

Changeover between heating, intermediate and cooling cycles is completely automatic. A Pneumatic Step Controller minimizes power demands by varying and limiting the capacity of the three 100-h.p. refrigeration compressors in 50-ton increments. Other Johnson Controllers regulate water pressures throughout the system and control the admission and discharge of well water.



T-1000 Recorder-Controller



G-180 Pneumatic Step Controller

T-800 Remote Bulb Thermostat

# Thompson Products, Inc.

Aircraft fuel pump assembly line

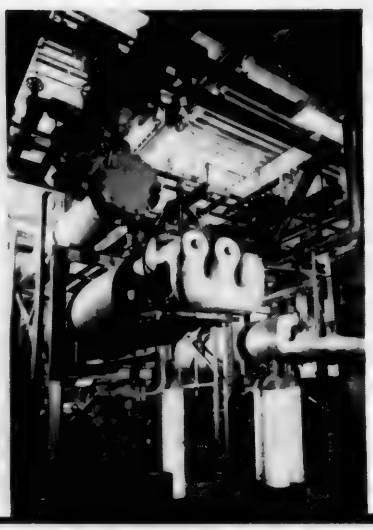
Air conditioned Engineering office

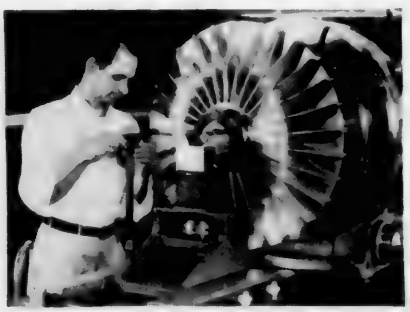
## Thompson Products, Inc. TAPCO PLANT, Cleveland, Ohio

One of the 16 Factories owned by this pioneer manufacturer of Automotive, Aircraft, Industrial and Electronic Products.

**POWERS CONTROL** is used in the majority of Thompson factories. In TAPCO plant, Administration and Engineering offices, production areas, research laboratories and test cells, cafeterias, CRAWFORD HALL auditorium and some processes are equipped with Powers temperature and humidity control.

**Below**: Installation for testing turbine drives





**Above**: Index head for inspection of vane wheels

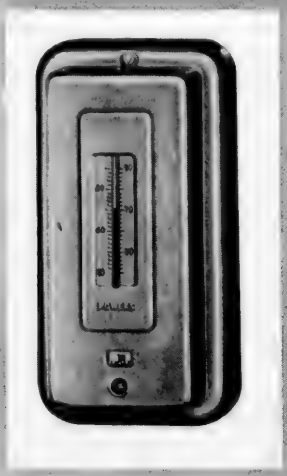
**Left**: Refrigeration system for cooling test fuels

# increases production...lowers costs...

## with POWERS Systems

## *of Temperature, Humidity & Ventilation Control*

*In Thompson's TAPCO plant, production of high-quality precision products is aided by Powers control in production and assembly-line areas; test and research laboratories; administration and engineering offices.*



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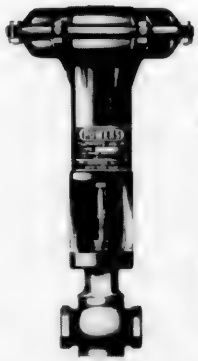
**Comfortable, Even Heat at the Right Temperature** for each space or department helps increase efficiency of employees and results in these money saving advantages:

- **Increased Production.** Thermal comfort helps employees increase output and maintain production schedules.
- **Better Quality Products,** fewer rejects, better workmanship, more uniform quality.
- **Cuts Heating Costs Up to 25%.** Powers Control Systems prevent OVER-heating and stop waste of fuel. Steadily advancing fuel costs make this an important advantage. Lower heating costs alone pay a big return on the investment in Powers automatic control.

**Powers Control Systems** Perform Better and Last Longer. Year after year users report 25 to 40 year old Powers control systems still giving dependable regulation. When you make a major investment in a control system select one with a time proven record for long life, low operating and maintenance cost. Specify and install Powers.

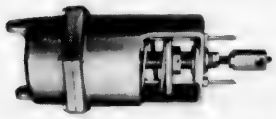
**Consult Powers on Space Heating or Process Control.** If you have a temperature or humidity control problem, contact your nearest Powers office. Our experience gained in thousands of buildings and processes may save you time and money.

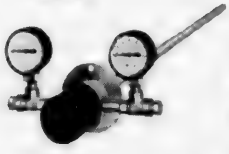
**Some of the many components used in a Powers pneumatic control system**



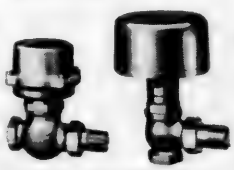
**FLOWRITE**
Control Valve

**POWERSTROKE**
Piston Operators for dampers

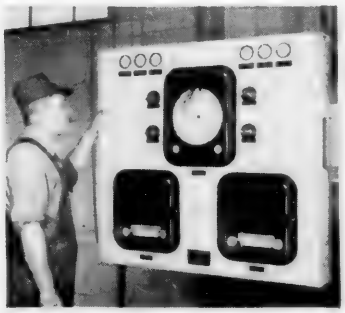


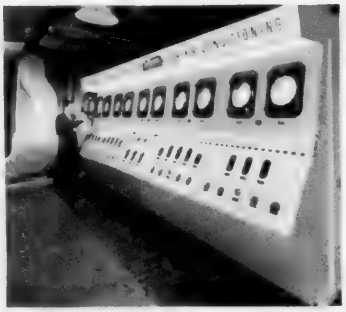


**LIMITEM Thermostat** for air temperature in ducts and processes.



**POWERS PACKLESS Control Valves**—Their duo-seal construction reduces valve stem friction, eliminates packing maintenance and leakage of water or steam and gives smooth accurate control.





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*Over 65 years of Automatic Temperature and Humidity Control*

POWERS CONTROL

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# NEW JENN-AIR

## Quiet-tested ROOF EXHAUSTER

WITH U-SPRING CUSHION SUSPENSION MOUNTING

This new Quiet-Tested Roof Exhauster design [illegible] power greater line [illegible] Exhausters at Narrow Cushion Suspension Mount [illegible] to the base of the unit, thus achieving a quietness never before possible. Patents pending.

Jenn-Air Exhausters on production line moving up for testing. Every Unit is line-lab tested for vibration, sound, motor load and insulation break-down before leaving the plant.

Here is the Vibronic Eye test chamber along the production line. Through the window is shown a Quiet-Tested Exhauster which has just moved into position for testing. This final check eliminates the element of human error.

Here's a new "hush-hush" product that *isn't* being guarded against discovery . . . in fact, Jenn-Air unwraps its exclusive Quiet-Tested Roof Exhauster for all to see . . . *NOW*. It is hailed as the most significant engineering advance in power exhausters since low contour design—a Jenn-Air First. Now, for the first time, a power exhauster is offered that's truly quiet.

**U-Spring Cushion Suspension Mounting Cuts Vibration—Lowers Noise Level**

A new principle of power assembly mounting is introduced in this new Jenn-Air Exhauster. U-springs suspend the power unit so it is cushioned against vibration . . . an exclusive Jenn-Air feature. New design in fan blade and housing reduces air velocity. In addition to the usual dynamic and static blade balance, a further critical test is made . . . the motor and blade are balanced together . . . another Jenn-Air exclusive. *All this adds up to the lowest noise level ever achieved in power exhausters.*

**Every Quiet-Tested Exhauster Individually Checked by Exclusive VIBRONIC EYE**

Every Quiet-Tested Unit is individually checked under simulated operating conditions by the exclusive Vibronic Eye in a sound control room. It works this way. First, a standard of acceptable quietness is established . . . then the Vibronic Eye tests every exhauster for vibration and noise. A further test is made for motor load and insulation break-down. Those are examples of the ceaseless search to improve products by Jenn-Air. So, look to Jenn-Air for better engineered exhausters—designed and line tested to perform beyond any in the field.

*"Ratings in accordance with standard test code by the Texas Experiment Station"—determined in accordance with procedures as set forth by NAFM and ASH&VE.*

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## BEAUTIFUL STYLING . . . EYE-LEVEL READING

As new as tomorrow . . . that's what furnace manufacturers and dealers said when they first saw the Classic . . . and you'll agree with them the first time you install one of these smartly designed thermostats on your next job.

The satin-gold case and black dial with its easy-to-read numerals complements the color scheme of any room.

But enough about its beauty . . . that's obvious . . . what you want to know is how much does it cost and how easily it can be installed.

Yes, it looks like more money but it costs no more than other makes . . . and that's important to you, but equally as important is the fact that the Classic's wiring system is standard 2-wire low voltage—and it will practically replace any thermostat without wiring changes!

Now, add up these exclusive selling features of the Classic and compare them with other thermostats of any shape, size or style and we're sure you'll want to find out more about it by calling one of the Detroit Controls representatives in your district or writing us today for full information.

## TIMED CYCLING Ends "HOT" and "COLD" Periods

Here is another Detroit Controls exclusive selling feature . . . Timed Cycling . . . the device that actually anticipates the heating needs of the home . . . controls room temperature within a fraction of a degree . . . provides the ultimate in heating comfort by eliminating over and under heating. Find out more about Classic, the "self-governing" thermostat, by writing for descriptive folder Form 1687 today.

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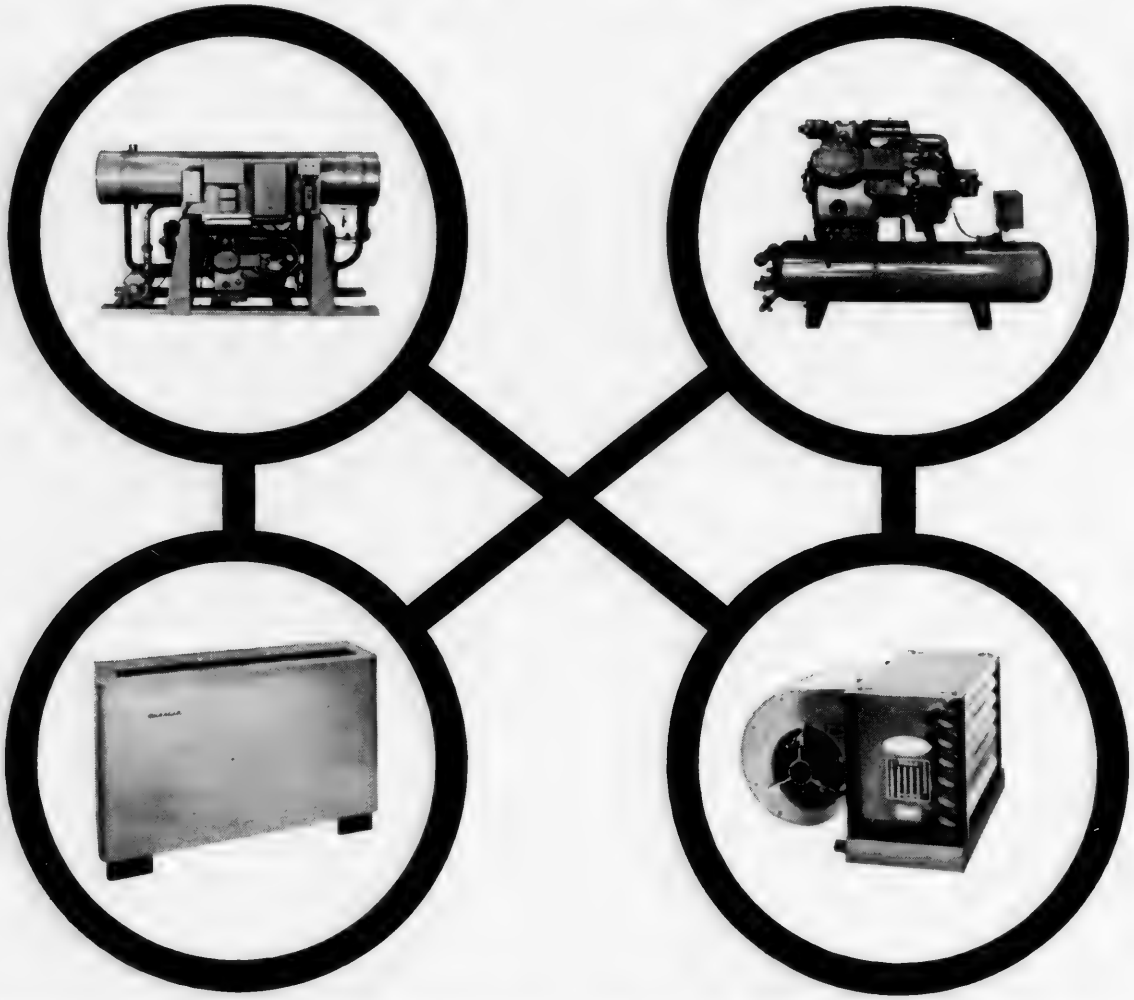
AIR CONDITIONING • DOMESTIC HEATING • AVIATION • TRANSPORTATION • HOME APPLIANCES • INDUSTRIAL USES

# 4 NEW WAYS TO AIR CONDITION

**Latest Carrier equipment opens up new design possibilities for fan-coil systems in new and existing multi-room buildings**

**Carrier's new Water Cooling Machines** are complete refrigeration packages. Can supply chilled water for cooling to new Weathermakers shown below. Or they can be used for process cooling. Evaporative condenser models: 3 to 60 hp. Water-cooled models: 3 to 200 hp.

**Carrier's new Hermetic Condensing Units** are designed for air conditioning or commercial refrigeration systems. Can provide direct expansion cooling for Weathermakers shown below. Water-cooled models: 2 to 10 hp. Air-cooled models: 2 and 3 hp.



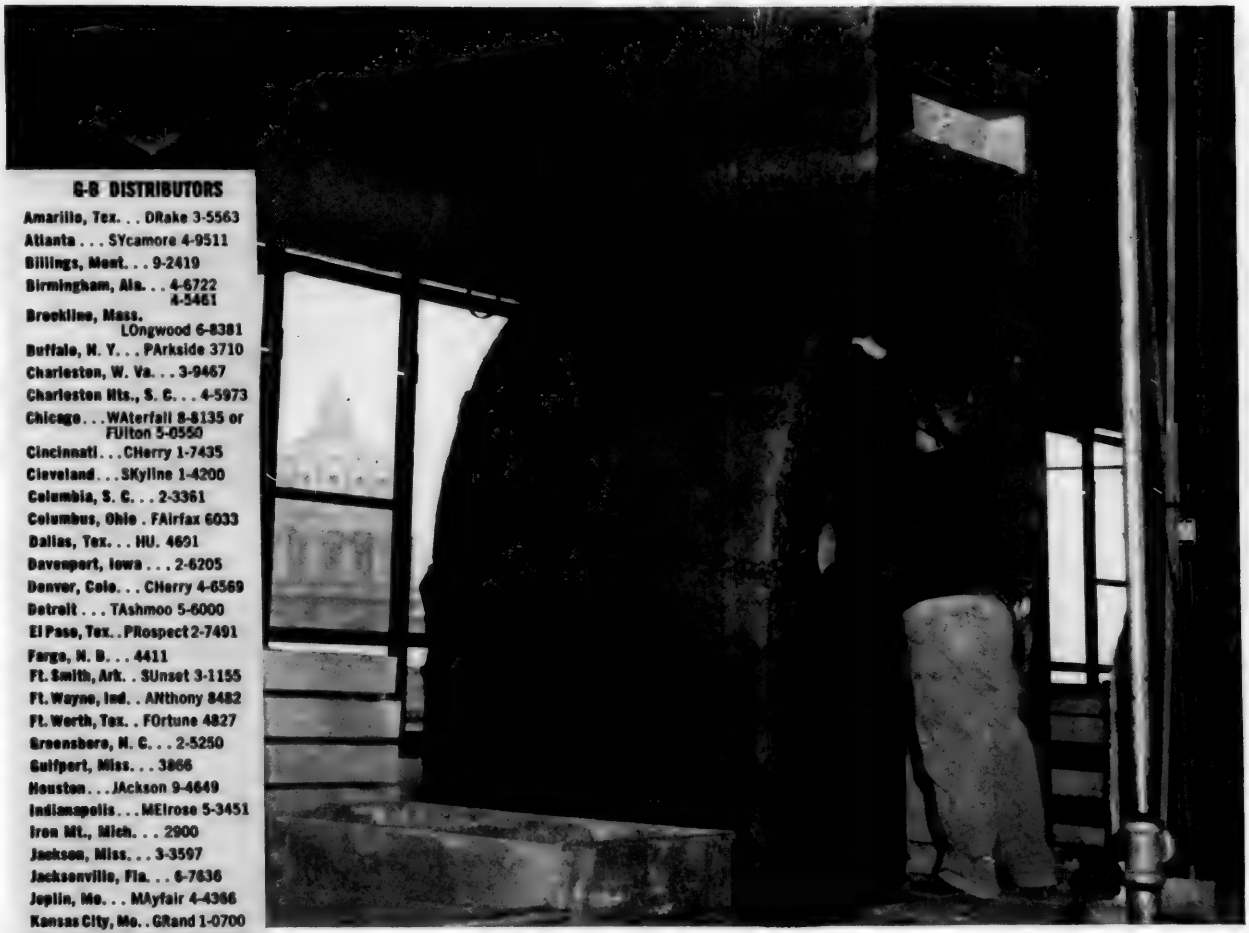
**New Room Weathermakers*** provide individual room control of heating and cooling. Designed for direct expansion or chilled and hot water systems. Can be installed horizontally or vertically, with or without cabinet. These fan-coil units are available in ½, 1, and 1½ ton sizes.

**New Unit Weathermakers*** are low-cost fan-coil units designed for overhead installation. Individual control of heating and cooling makes these units ideal for multi-room buildings. For direct expansion or chilled and hot water systems. In ½, ¾ and 1 ton sizes.

*Reg. U.S. Pat. Off.

**first name in air conditioning** Carrier

For further information and literature, call your Carrier dealer listed in the Classified Telephone Directory. Or write Carrier Corporation, Syracuse, N.Y.



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# *Low heat loss is "Capitol gain"... thanks to* ULTRALITE

On "Capitol Hill" in Harrisburg stands the new Pennsylvania State Office Building* — a modern monument to streamlined government.

Throughout this 11-story structure, 60,000 sq. ft. of combination heating-cooling ducts are insulated with ULTRALITE, the only insulation of long glass fibers. In such a vast system, the control of temperature is extremely important — and vibration can also be a potential problem. That's where ULTRALITE comes in. Its superior thermal efficiency will hold heat loss and heat gain to a minimum and this rugged, resilient insulation will dampen vibration indefinitely without insulation damage or loss of thickness.

But performance is only part of the ULTRALITE story. Its many unique physical properties and handling characteristics make it the *most economical duct insulation* you can apply. And ULTRALITE is more readily available than any other glass fiber insulation — as you can see by the adjoining column that lists your nearby distributor.

*Architects: Lacy, Atherton and Davis. Genl. Contractor: Ritter Brothers. Insulation Contractor: Triangle Insulation Co., Philadelphia.

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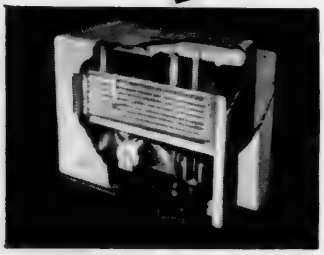
## GUSTIN-BACON *Manufacturing Company*

Thermal and acoustical glass fiber insulations • Pipe coverings and fittings • Molded glass fiber pipe insulation

222 W. 10th St., Kansas City, Mo.

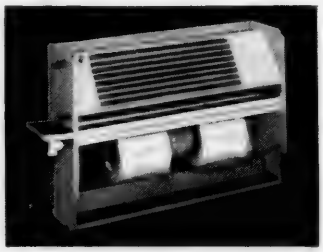
# *Now—your choice*

## for year-round air conditioning of commercial and institutional buildings—from **MUELLER CLIMATROL**



*For*
self-contained cooling . . . central steam or water heating

*For*
central cooling and hot water heating systems



*Recessed Air Conditioner.* Individual room control saves fuel and power costs — unit works only when needed. You can offer heating *and* cooling for about half the cost of a complete central system. Can be installed room-at-a-time on budgeted program, without disturbing tenants. Efficient one-hp refrigeration cycle uses no water.

*Fan Coil Units.* Both recessed and cabinet types, in the most complete range of floor-mounted sizes — 200, 300, 400 and 600 cfm. Twin blowers draw room air through permanent filter (standard), blend it with fresh outside air if desired, force it over coil that circulates hot or chilled water. Four-row coil gives better dehumidification.

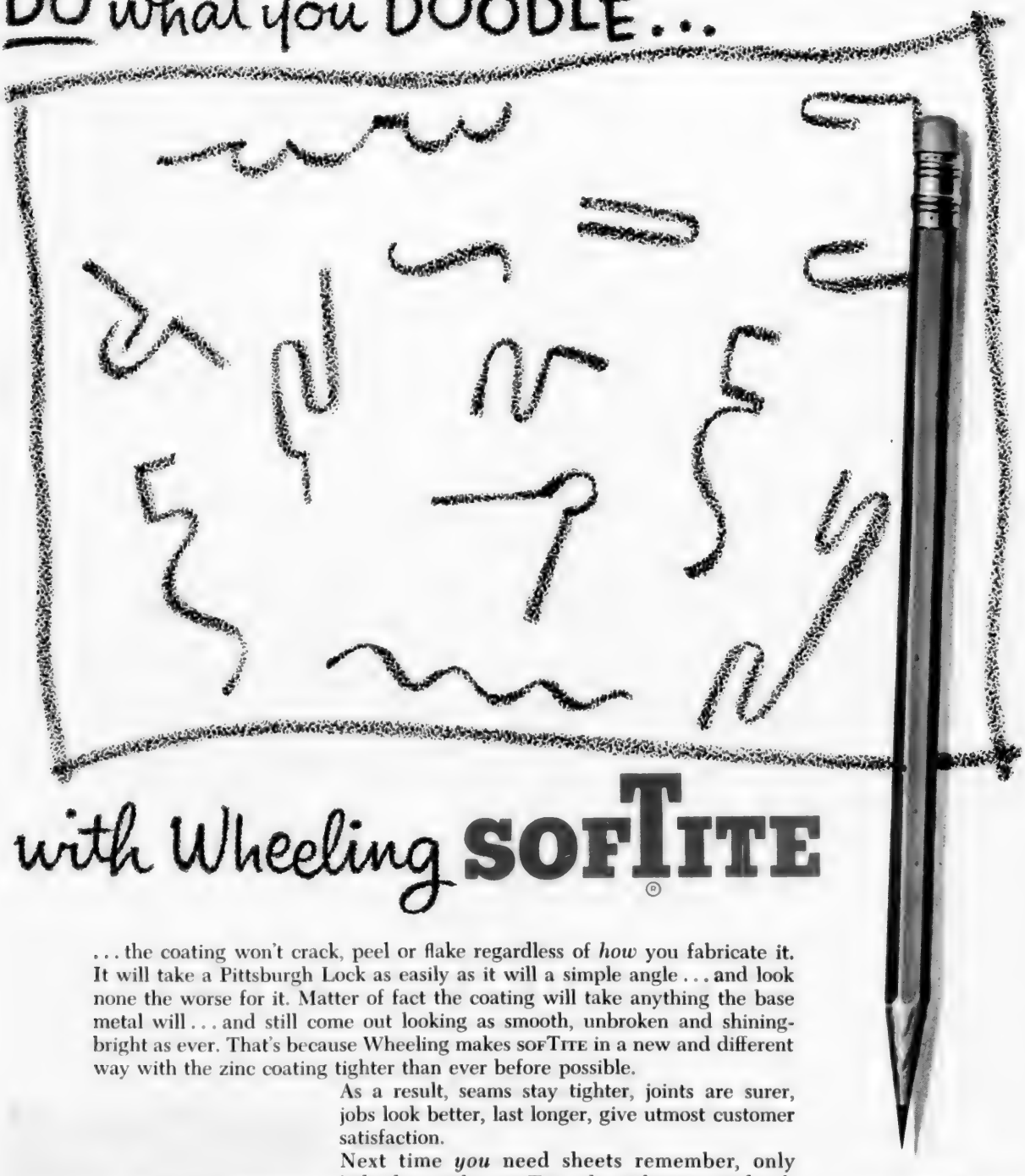
With this pair of outstanding units, you've an inside track in your bids for multi-room heating and cooling installations. *For new buildings,* both design and performance stand out as the ultimate in modern comfort concepts.

*As replacements,* their economy and ease of installation add convincing weight to the magic appeal of all-year air conditioning. For closer study of facts, specifications and installation data write for literature.

**Mueller Climatrol**

Department 56
2060 W. OKLAHOMA AVE. • MILWAUKEE 15, WIS.

# DO what you DOODLE...



## with Wheeling SOFTITE®

... the coating won't crack, peel or flake regardless of *how* you fabricate it. It will take a Pittsburgh Lock as easily as it will a simple angle ... and look none the worse for it. Matter of fact the coating will take anything the base metal will ... and still come out looking as smooth, unbroken and shining-bright as ever. That's because Wheeling makes SOFTITE in a new and different way with the zinc coating tighter than ever before possible.

As a result, seams stay tighter, joints are surer, jobs look better, last longer, give utmost customer satisfaction.

Next time *you* need sheets remember, only *Wheeling* makes SOFTITE, the tightest-coated galvanized sheet available. Get in touch with the Wheeling warehouse or sales office nearest you for full details.

***This is Wheeling's Detroit warehouse.*** Other Wheeling warehouses and sales offices are strategically located throughout the country. They all offer immediate delivery of warehouse-stocked Wheeling items such as SOFTITE Cop-R-Loy Galvanized sheets, Galvanized Furnace Pipe, snap lock or closed seam Perimeter Heating or Air Conditioning Pipe, and accessories.

Wheeling

**WHEELING CORRUGATING COMPANY, WHEELING, WEST VIRGINIA**

**Warehouses:** Boston, Buffalo, Chicago, Columbus, Detroit, Kansas City, Louisville, Minneapolis, New Orleans, New York, Philadelphia, Richmond, St. Louis. **Sales Offices:** Atlanta, Houston.

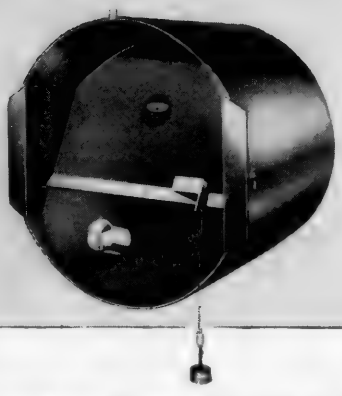
**DEPENDABLE,**

**PRECISELY ACCURATE**

# Draft Control

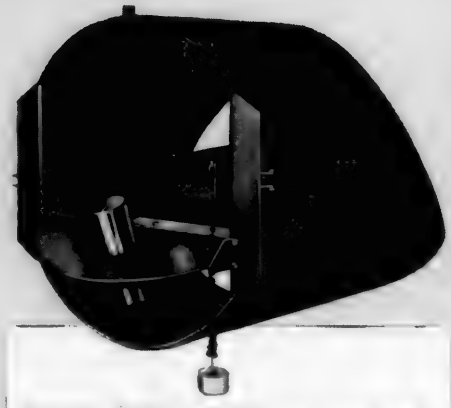
***for coal fired, oil fired, gas fired or gas-oil fired***

## HEATING PLANTS



### FIELD TYPE "M" for coal and oil fired heating plants

Heavy duty commercial model in 28" and 32" sizes. Heavy, rigid construction assures long, trouble free service. Stainless steel knife edge bearing for permanent sensitivity. Also available in 6" through 24" sizes for domestic and commercial installations. First choice of heating men — the round control you can level on any flue.



### FIELD TYPE "MG" for gas and gas-oil fired heating plants

A heavy duty, precision built control in sizes 8" through 32" for commercial and industrial installations. Stainless steel knife edge bearings for permanent sensitivity. Gate opens inward to regulate updrafts, and outward to relieve down-drafts. Optional safety switch available where codes require. Fully proven, accepted virtually everywhere.

## *They're real* HEAVYWEIGHTS

Compare the weight of a Field Control to any other available. Here is proof of the massive, welded construction, long, vibration-free service, that permits Field's supreme accuracy.

| Size Control | Gate | Thickness of Parts Side Plates | Ring | Collar | Wt. without Crtn. or Crate |
|---|---|---|---|---|---|
| 14 M | 16 Ga. | 16 Ga. | ⅛ x 2" | 22 Ga. Galv. | 19# |
| 16 M&MG | 16 Ga. | 16 Ga. | ⅛ x 2" | 18 Ga. Galv. | 28# |
| 18 M | 16 Ga. | 16 Ga. | ⅛ x 2" | 18 Ga. Galv. | 35# |
| 20 M&MG | 16 Ga. | 16 Ga. | ¼ x 2" | 18 Ga. Galv. | 41# |
| 24 M&MG | 14 Ga. | 16 Ga. | ¼ x 2" | 18 Ga. Galv. | 65# |
| 28 M&MG | 14 Ga. | 14 Ga. | ¼ x 4" | 14 Ga. H.R.S. | 110# |
| 32 M&MG | 14 Ga. | 14 Ga. | ¼ x 4" | 14 Ga. H.R.S. | 140# |

See our complete new exhibit at the National Oil Heat and Air Conditioning Exposition at the New York City Coliseum, June 11-15, 1956. Space No. 246.

**field**

**FIELD CONTROL DIVISION**

of H. D. CONKEY & COMPANY, Mendota, Ill.

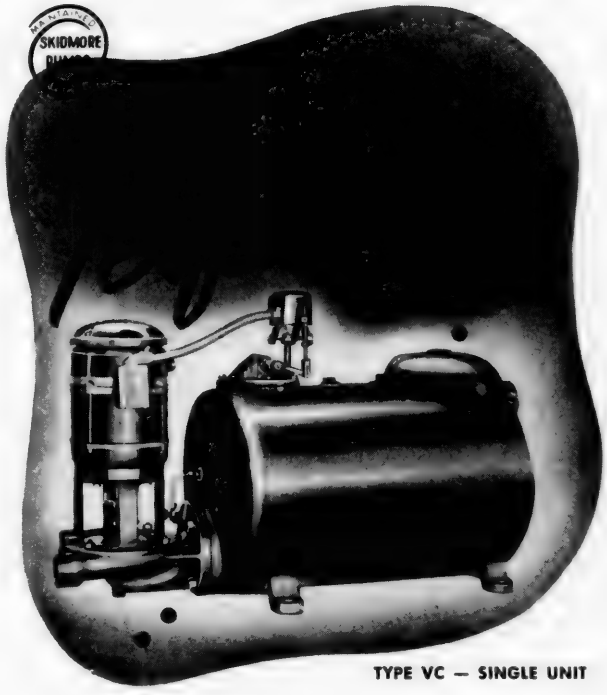
Affiliates

Conco Building Products, Inc. • Brick, Tile, Stone
Conco Materials Handling Division • Cranes, Hoists

# ELIMINATE YOUR HEATING PUMP PROBLEMS—FOR GOOD!

## call in a Skidmore Specialist

*There's no need for heating engineers, architects or contractors to worry these days — they know the record of performance and continuous service of Skidmore Pumps throughout the years — they know that from this one source (The Skidmore Heating Pump Specialist) you can get experienced council on every type of pump installation. Tailored to your specific needs — you eleminate your pump problems "for good." There's a Skidmore Specialist in every principal city — call him today!*




TYPE VC — SINGLE UNIT

The Skidmore Type VC Condensation Pump and Receiver has low inlet connection . . . operates quietly . . . impeller is bronze centrifugal enclosed type. Especially designed for handling hot condensate, entire unit can be removed for inspection or repair without disturbing piping connections. Skidmore Pumps are furnished in either single or duplex type according to installation requirements.

For complete information write for SKIDMORE VC Bulletin No. 10-B.

**TYPE UV CONDENSATION PUMP**

Where returns are too low to permit the operation of horizontal type pumps — the Skidmore UV Pump performs very satisfactorily. Consists of vertical pump and motor unit with float and float switch mechanism mounted on sump type receiver unit. Write for Bulletin No. 19-B. Also furnished in duplex.

TYPE "UV" SINGLE UNIT

SKIDMORE PUMPS — SKIDMORE CORPORATION ST. JOSEPH, MICHIGAN

# INSUL-ITE

## NATURE'S OWN INSULATION FOR UNDERGROUND PIPES

*Protects Pipe* from HEAT LOSS, CORROSION, ACIDS OR ALKALIS

**INSUL-ITE is a special blend of a natural hydrocarbon which fuses itself to the pipe and forms a thick protective coating of insulation which requires no maintenance, need not be replaced or repaired.**

- **Unbelievably SIMPLE . . . Requires no skill to install, no special equipment.**
- **Amazingly EFFECTIVE . . . Can be used under any conditions, regardless of the number or size of pipes.**
- **Undeniably ECONOMICAL . . . No wrapping of pipe necessary . . . just backfill the trench with INSUL-ITE instead of earth.**
- **Can be used for HOT or COLD liquids or vapors.**

**DISTRIBUTOR TERRITORIES AVAILABLE**

*For further information write:*

**G. S. ZIEGLER & COMPANY**

**99 CHURCH STREET,**

**NEW YORK 7, N. Y.**

ZIEGLER

# The answer to LARGE AREA HEATING...

# KRITZER

## SLOPE TOP STB Radiant Baseboard

KRITZER STB (Slope Top) is a high capacity baseboard used in schools, hospitals, institutions, and other large area heating applications. It is made of heavy gauge steel, die-formed with safe rounded edges to withstand the knocks and bumps of everyday use.

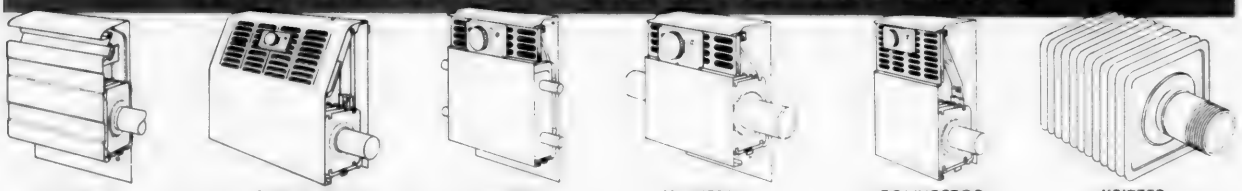
Clean lines and attractive appearance make KRITZER STB at home in any interior . . . institutional, commercial, industrial.

Performance is assured . . . KRITZER coils, with covers, are thoroughly tested in the industry's most modern research laboratory. Ratings are Certified. All products guaranteed for materials and workmanship.

KRITZER is the world's largest *exclusive* manufacturer of radiant baseboard. Buy Kritzer. Get the latest . . . Get the best!

KRITZER RADIANT COILS, INC. 2901 Lawrence Ave., Chicago 25.

## KRITZER QUALITY HEATING PRODUCTS



"K" LINE BASEBOARD | SLOPE TOP BASEBOARD | STANDARD BASEBOARD | UNIVERSAL BASEBOARD | CONVECTOR, SLOTTED FRONT | KRITZER FINNED TUBE

# KRITZER

REPRESENTATIVES IN PRINCIPAL CITIES

SEE YOUR JOBBER FOR KRITZER PRODUCTS

*"IF IT'S KRITZER, IT'S RIGHT, SIR!"*

**Dunham Finned Tube Radiation** in main reception room used with METRO simplified method of piping at Assumption Hall, Duquesne University. Along-the-wall radiation is also available in four other styles—fits in anywhere.

**Heating Contractor:** George H. Soffel Co., Inc., Pittsburgh, Pa.

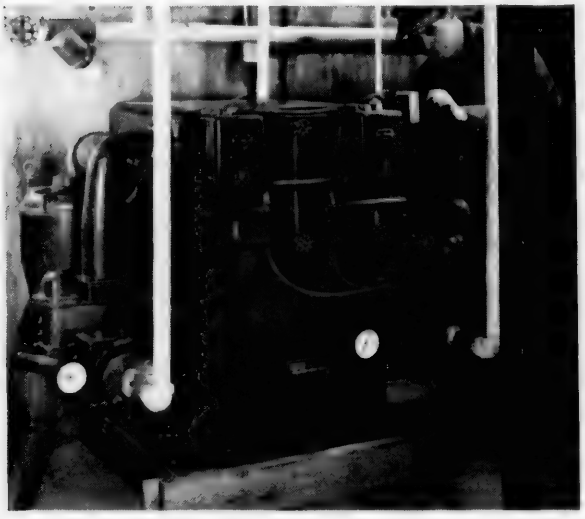
**Architect:** William York Cocken, Pittsburgh, Pa.

**General Contractor:** Duquesne University Department of Engineering, Pittsburgh, Pa.

# *Duquesne University knows that it pays to depend on DUNHAM*

**Dunham Type M Unit Heater** in cafeteria at Assumption Hall, Duquesne University. Twin blower fans directly mounted on motor shaft distribute heat evenly and quietly over large area.

**Dunham Convector** in dormitory rooms . . . painted to blend with wall. Individual room heat control assured by knob-operated damper. Chain-operated damper available.



**Dunham Vacuum Heating Pump**—"heart" of the fuel-saving VARI-VAC® system. Keeps subatmospheric steam circulating under vacuum, produces pressure differential between supply and return METRO® piping. Quickly pulls air and condensate from system.

**Dunham VARI-VAC Control Panel** in Assumption Hall. Provides centralized, one-man operating station for all system settings and remote control readings. The electronic "brain" of this system saves up up to 40% on fuel.

*Duquesne University* officials know from experience you can depend on Dunham for *all* heating equipment needs . . . from a simple radiator trap to fully engineered precision control systems that assure greater comfort for fewer fuel dollars.

That's why Dunham heating equipment is used throughout to heat Assumption Hall, Duquesne's beautiful new girls' dormitory. All radiation, unit heaters, vacuum pumps, temperature controls and heating specialties bear the brand—Dunham.

For that next job—regardless of what type of equipment you need—why not depend on Dunham, as thousands of others have, so that full responsibility for delivery and performance rests with one manufacturer?

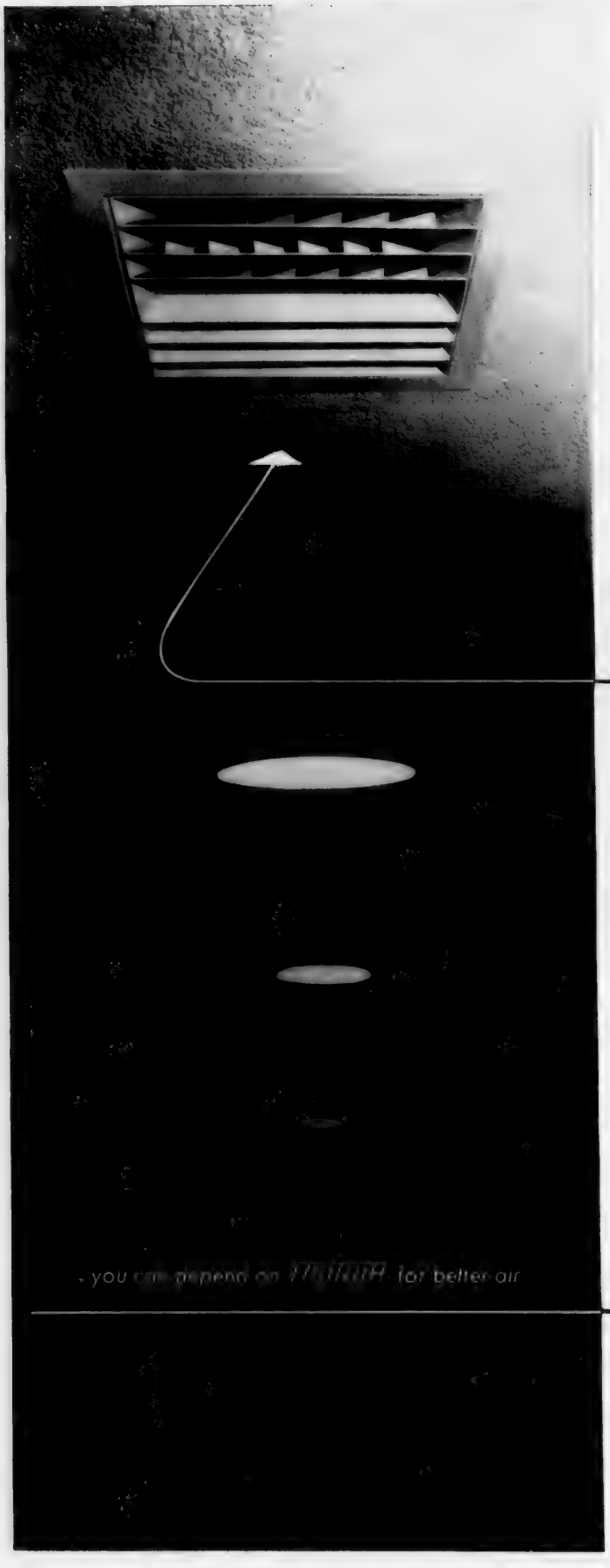
For full information about the *complete* Dunham line, write for Bulletin ACHV-5, C. A. Dunham Company, 400 W. Madison Street, Chicago 6, Ill.

DUNHAM®

**HEATING & COOLING EQUIPMENT**

**RADIATION • CONTROLS • UNIT HEATERS • PUMPS • SPECIALTIES**

**C. A. DUNHAM COMPANY • CHICAGO • TORONTO • LONDON**




*Custom Made*

## AIR DIFFUSERS with DIFFUSING VANES

**Each AGITAIR square and rectangular air diffuser is custom designed to meet your requirements of air flow and interior treatment.**

**These AGITAIR diffusers have built-in diffusing vanes, scientifically arranged in unlimited louver patterns to provide certified 100% draftless air distribution from any ceiling or wall location.**

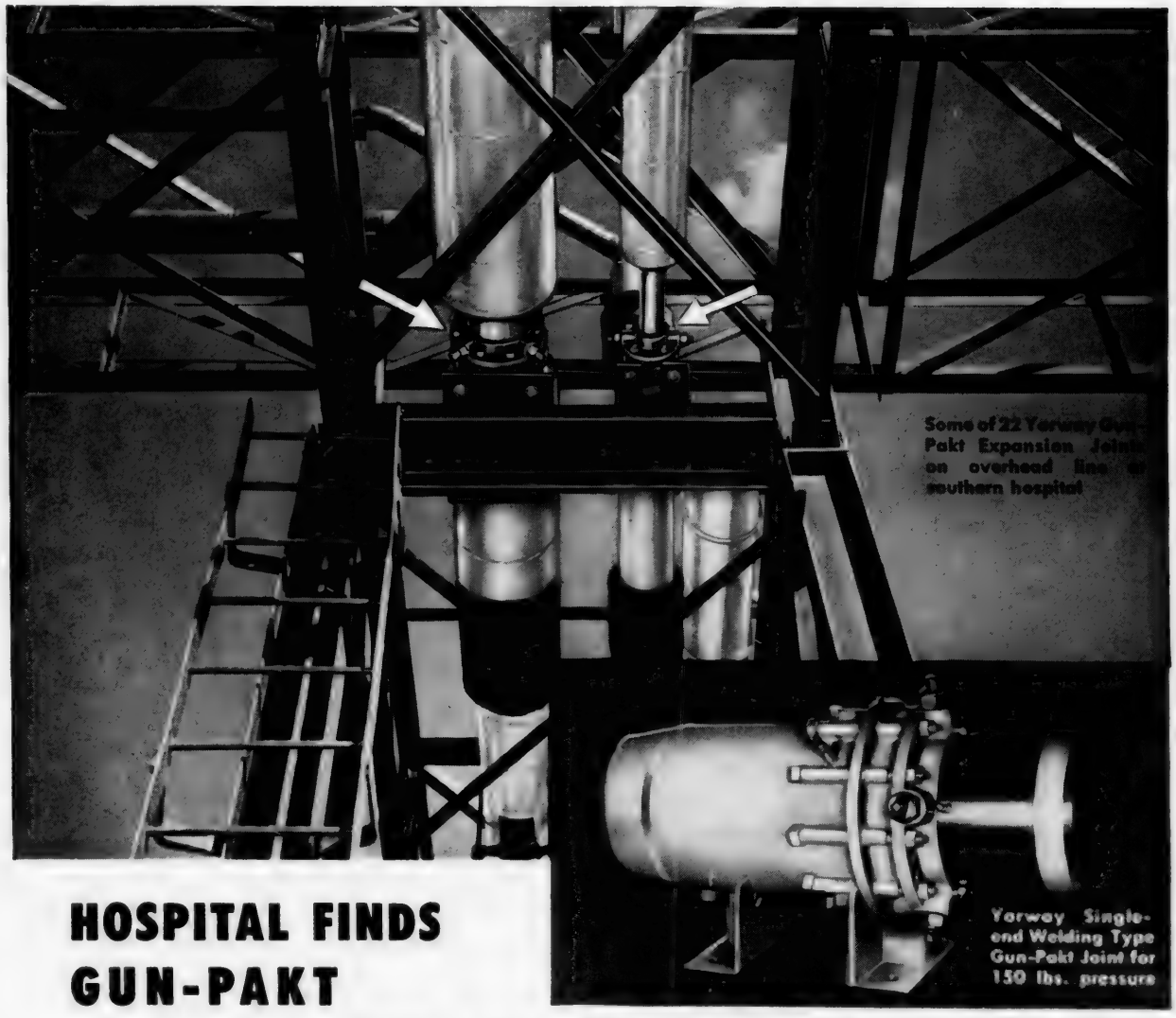
**AGITAIR Catalog R-107 shows you how to select the proper size and pattern for your job conditions.**

***Write for your copy today.***

## AIR DEVICES INC.

**185 MADISON AVENUE, NEW YORK 16, N. Y.**

**air diffusers • filters • exhausters**


Some of 22 Yarway Gun-Pakt Expansion Joints on overhead line of southern hospital
Yarway Single-end Welding Type Gun-Pakt Joint for 150 lbs. pressure

# HOSPITAL FINDS GUN-PAKT *SURE CURE FOR EXPANSION JOINT TROUBLES*

YARWAY Gun-Pakt Expansion Joints are just what the "doctor" ordered for this overhead steam line at a large southern hospital—and he ordered 22 of them!

In institutions, industrial plants and other large steam distributor systems YARWAY Gun-Pakt Joints are growing in popularity.

YARWAY Gun-Pakt slip-type joints give long life—no fatigue failures.

You need *fewer joints per length of line*, with traverses up to 12" single and 24" double.

With Gun-Pakt joints packing may be added as necessary, *under full steam pressure right on the job—no unpacking, no shutdowns.*

There's also *lower pressure load on end anchors* because excessive strains are eliminated.

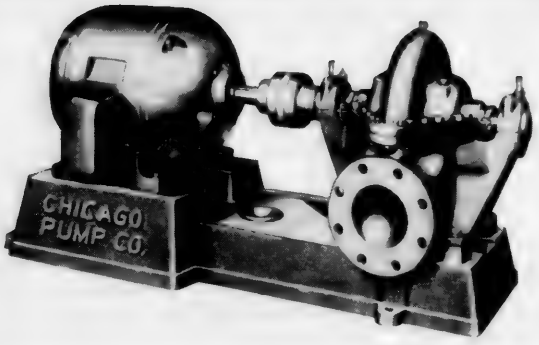
All these are reasons why it will pay you to "do as the doctor ordered"—look into YARWAY Gun-Pakt Expansion Joints. Write for Bulletin EJ-1914.

**YARNALL-WARING COMPANY**
104 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

**GUN-PAKT EXPANSION JOINTS**

FROM *Chicago* TOP QUALITY PUMPS

Engineered for plumbing, heating, and air conditioning systems

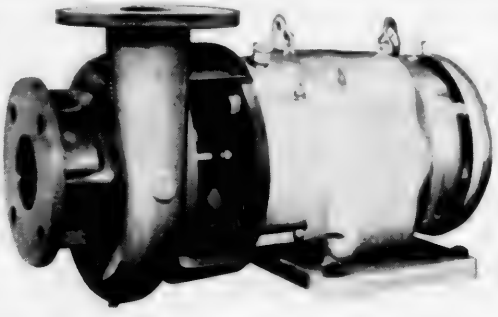


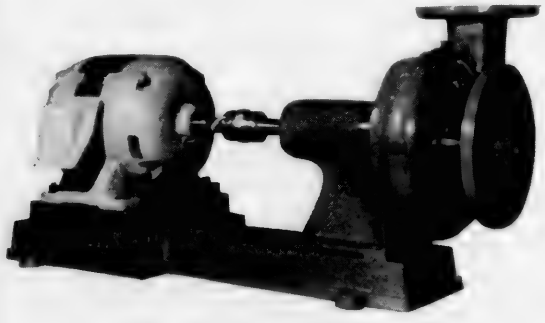

**TYPE D DOUBLE SUCTION HORIZONTALLY SPLIT CASE PUMP**

A rugged, heavy-duty pump that guarantees long, trouble-free service. The rotating assembly may be inspected without disconnecting the piping. Capacities up to 1900 G.P.M. Heads to 530 Ft. Described in Bulletin 101.

**TYPE CC CLOSE COUPLED PUMP**

Handles the toughest pumping jobs efficiently and in the least possible space. May be mounted in any position as long as the motor is not lower than the pump. Equipped with leak-proof mechanical seal. Capacities up to 500 G.P.M. Heads to 215 Ft. Described in Bulletin 108.





**TYPE FC PEDESTAL MOUNTED FLEXIBLE COUPLED PUMP**

Like the CC, all FC pumps are equipped with the most reliable mechanical seal ever built into a pump. Ceramic-faced stationary seat is highly resistant to wear. Accurately lapped surfaces and automatic adjustment for wear assures long life under strenuous service. Described in Bulletin 107.

**For trouble-free, "worry-proof," efficient pumping at all times — specify Chicago Pumps. Write for complete information.**

fmc **CHICAGO PUMP COMPANY**

Subsidiary of Food Machinery and Chemical Corporation

**BUILDING PUMP DIVISION**

400 DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

Condo-Vac ®, Sure Return ®, AVC, LVC, Fire, House & Circulating Pumps, Pneumatic & Tankless Water Systems . . . Flush Kleen ® Sewage Ejectors, Little Giant ® & Non-Clog Rotor Pumps. Pumps for every industrial use.

# 1906

The open trolley car was a popular engineering contribution to summer-time comfort and pleasure. 1906 marked the introduction of the first *Brunner-engineered* product.

# TODAY

. . . with the newly-designed BAC "packaged" models, and a complete line of open-type condensing units.

**BRUNNER MANUFACTURING COMPANY, UTICA, N. Y.**
THE BRUNNER CO., GAINESVILLE, GA.
IN CANADA: BRUNNER CORP. (CANADA) LTD., TORONTO, ONTARIO

PROVEN QUALITY
50th Anniversary
BRUNNER
SINCE 1906
DEPENDABLE

New BAC "packaged" models are available in 3, 5, 7½ and 10 H.P. sizes. Smaller and more compact, these new units are attractively finished in Hammer-tone Green.

Open-type Condensing Units available in a wide range of sizes . . . ¼ through 100 H.P.

The NO-COMPROMISE

# HEATING-COOLING COMBINATION

## Webster Tru-Perimeter Forced Hot Water Baseboard Heating with compatible Warren Webster Cool Air System

In a Philadelphia suburb, these 85 Webster-heated Webster-cooled ranch homes at less than $15,000 point the way to year-round comfort in a quality house — without any compromise, winter or summer. Two completely independent, completely compatible systems — each providing unsurpassed comfort — give the builders of Stanwood Homes an advantage equalled only in costly custom-built dwellings.

At Stanwood, Webster Tru-Perimeter Forced Hot Water Baseboard Heating provides winter-long, draft-free comfort at low fuel cost. Installation is easy and economical . . . heating is installed after plastering.

And at Stanwood, Warren Webster Cool Air System gives summer-long comfort in rooms requiring cooling. Cooler utilizes glass fiber supply and return ducts, and a single plenum chamber of vaporproof insulation board. Ducts are easy and inexpensive to install. Registers, with dampers, give complete control of cool air distribution to each room. Central thermostat permits choice of full cooling in hot weather; fan-circulated filtered air in mild weather; complete shut-down in cool weather.

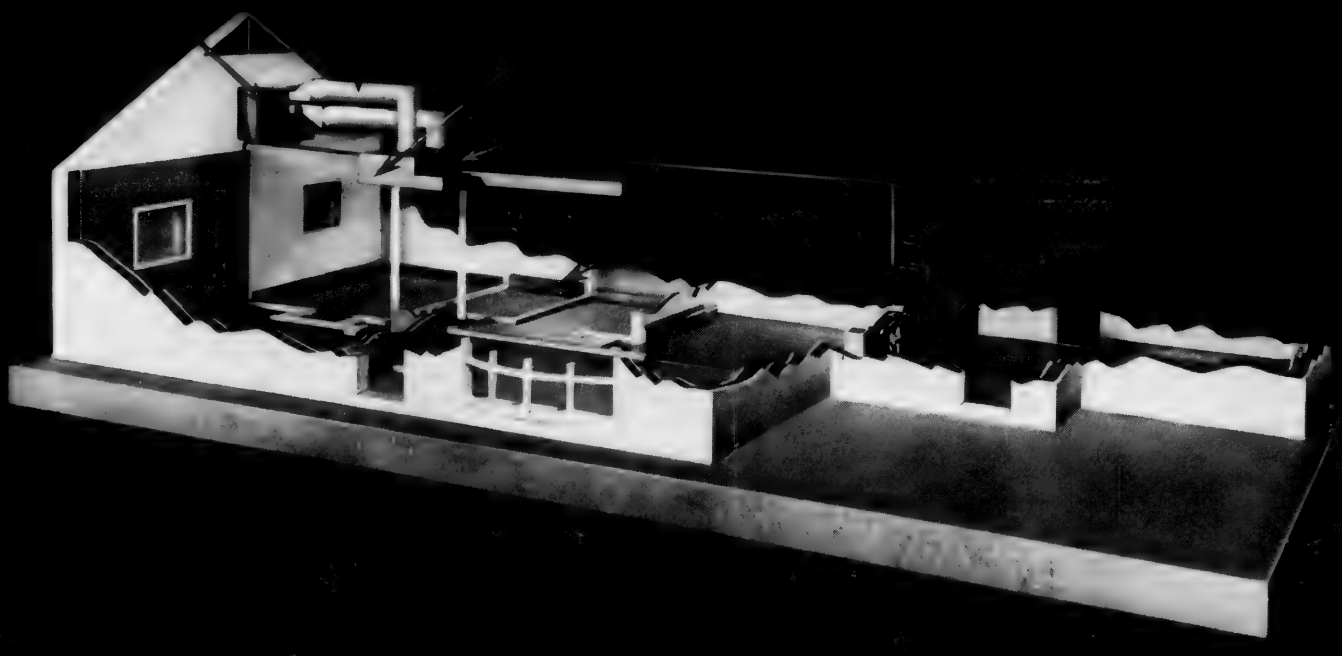
For information on Webster Baseboard Heating with compatible Warren Webster Cool Air System, see your Webster Representative, or write us.

Address Dept. HV-5

WARREN WEBSTER & COMPANY
Camden 5, New Jersey : : Representatives in Principal Cities
*In Canada, Darling Brothers, Limited, Montreal*

WARREN Webster
HEATING & COOLING EQUIPMENT

LOCATED NEAR YOU — TO HELP YOU. Webster Representatives in these 66 U. S. Cities: Albany, Atlanta, Atlantic City, Baltimore, Bethlehem (Pa.), Birmingham, Boston, Buffalo, Butte, Charleston (W. Va.), Chattanooga, Chicago, Cincinnati, Cleveland, Columbia, Columbus, Dallas, Davenport, Dayton, Denver, Des Moines, Detroit, Grand Rapids, Harrisburg, Houston, Indianapolis, Kansas City, Kingston (Pa.), La Porte (Ind.), Little Rock, Los Angeles, Louisville, Lubbock, Memphis, Milwaukee, Minneapolis, Nashville, Newark, New Haven, New Orleans, New York, Oklahoma City, Omaha, Orlando, Philadelphia, Pittsburgh, Portland, Raleigh, Richmond, Roanoke, Rochester, Saginaw, St. Louis, Salt Lake City, San Antonio, San Francisco, Seattle, Spokane, Springfield (Mass.), Syracuse, Toledo, Trenton, Tulsa, Washington, Wichita, Wilmington . . . In Canada, Darling Brothers Ltd., Montreal.



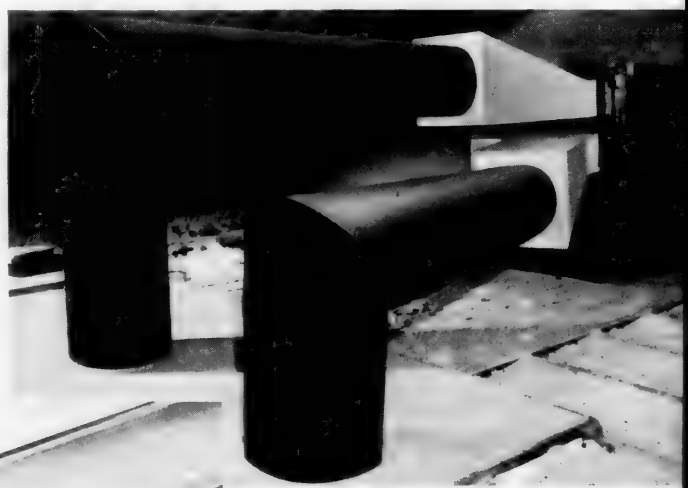
Model of Stanwood Home, Croydon, Pa., displayed at NAHB Show in Chicago. Shows independent Webster heating and cooling systems teamed smoothly for year-round comfort. Builder: Stanwood Corporation, Philadelphia. Project Manager: Glace & Glace, Inc., Harrisburg, Pa. Heating and Air Conditioning Contractor: Max Weiner & Sons, Philadelphia.

## Cooling Comfort Advantages of Warren Webster Cool Air System:

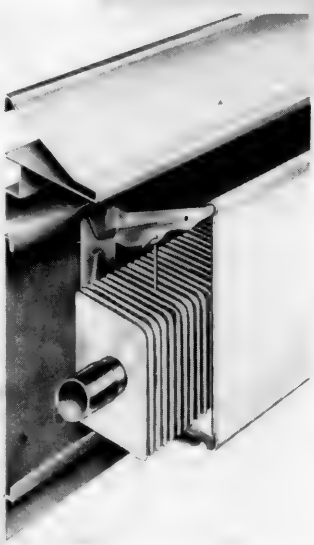
Cooling system completely independent of heating system
Ducts specifically designed for cooling only
Separate thermostatic controls for cooling and heating
Simple and quick installation — integral insulation and vapor seal
Air-cooled equipment in adequate range of sizes
Not a "room cooler"—Webster System cools entire house.

## Heating Comfort Advantages of Webster Baseboard Heating:

Forced hot water spreads clean, quiet, gentle heat along exposed walls
Heating is uniform and draft-free
No baked heat concentrations, no "smell" of heat
Gives comfort, even beside large windows
Controls provide easy regulation of heat delivery
Wasteful overheating avoided
Low fuel cost . . . economical maintenance
Permits complete freedom in furniture arrangement



Installation of Warren Webster Cool Air System, showing cooling unit with hermetically sealed refrigeration cycle and glass fiber supply and return ducts leading to plenum chamber.



Cut-away view of Webster Baseboard Heating, showing heating element of finned copper tubing behind metal baseboard. Note its simplicity.

Published in the interest of the Soft Drink Canners Association and the canning industry.

# No headaches in these drinks!

Eliminate the hazard of broken bottles in your plant by providing your employees the safety and convenience of canned soft drinks.

Call your soft drink supplier and learn the many advantages of dispensing drinks the modern way—in cans.

QUALITY YOUNGSTOWN SERVICE

Above are illustrated two of the modern cans for soft drinks, now available for in-plant use.

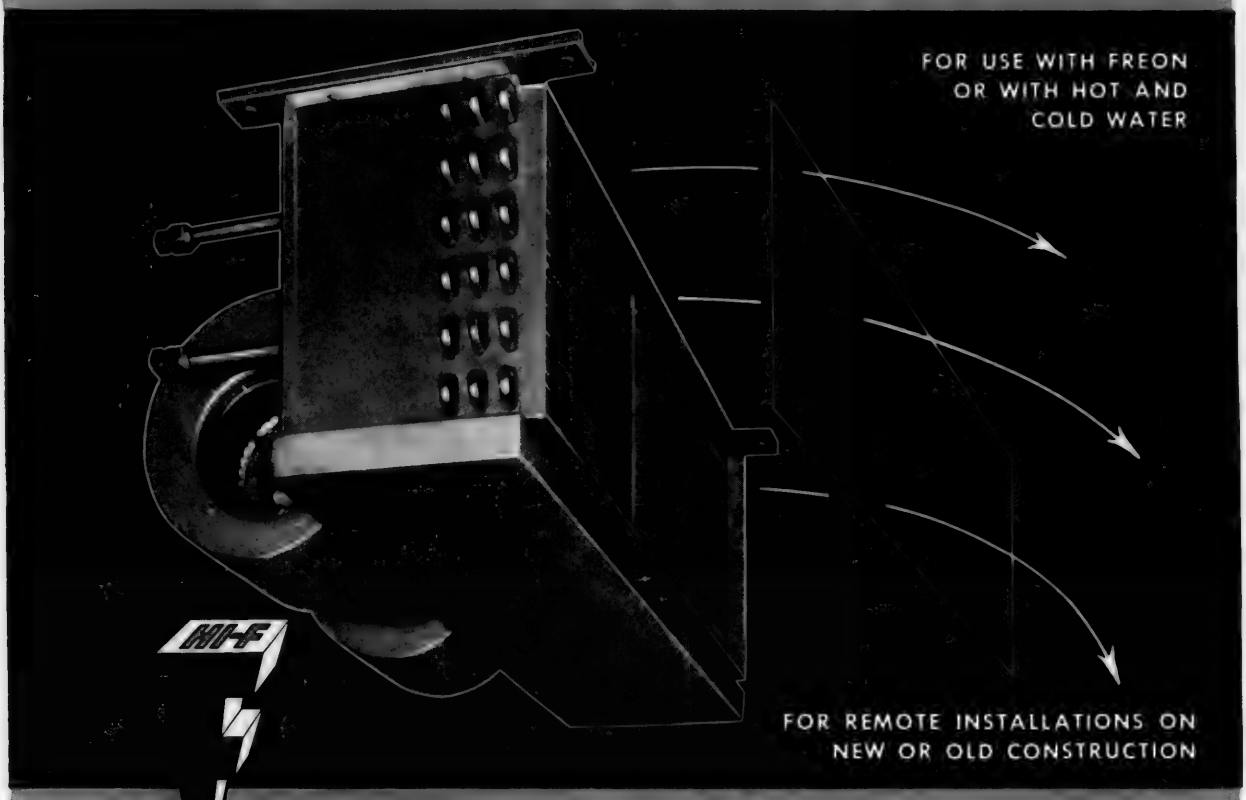
**THE YOUNGSTOWN SHEET AND TUBE COMPANY** *Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices Youngstown, Ohio District Sales Offices in Principal Cities.

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - BLACK PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS

# CONCEAL-X

## THE NEW AIR CONDITIONING UNIT THAT REQUIRES NO FLOOR SPACE




*for*

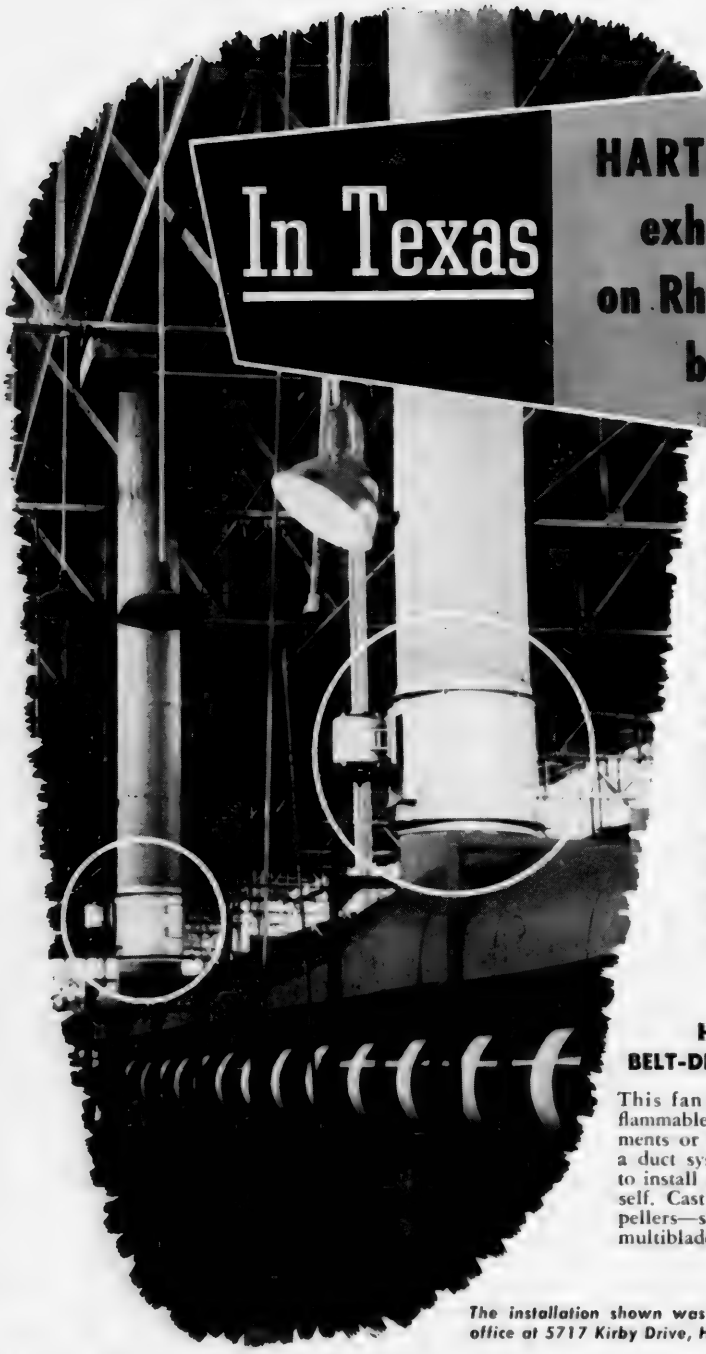
**MOTELS**
**HOTELS**
**HOMES**
**OFFICES**
**HOSPITALS**
**and**
**General Buildings**

Conceal-X is built to save you money, make you money, and to better satisfy your customer. It is a real space saver designed for use in out of the way places and with the capacity to do a big job *quietly*. Recommended for motels, dwellings and buildings for Winter-Summer air conditioning. Conceal-X, installed in vestibules, overhead entrance ways, plenums, closets or hallways with or without false or furred ceilings, provides horizontal discharge to one or several adjacent rooms. Best of all, Conceal-X incorporates the Peerless patent-applied-for Hi-F finned construction that gives you greater B.T.U. efficiency year after year. May we send you bulletin and specifications?

## PEERLESS OF AMERICA, INC.

MANUFACTURERS OF REFRIGERATION AND AIR CONDITIONING COILS SINCE 1912

Dept. A, 6600 N. PULASKI ROAD, CHICAGO 30, ILL., U.S.A.



# In Texas

## HARTZELL DUCT FANS exhaust smoke and fumes on Rheem's high-speed barrel production line

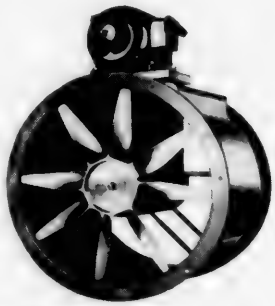
At the Rheem Manufacturing Company plant in Houston, Texas, two 24", 1 HP Hartzell belt-drive duct fans in a perforated head remove welding smoke and paint fumes along a high speed barrel production line. Other Hartzell fans power similar exhaust systems in every state in the Union.

Why should Rheem choose Hartzell? Because in thousands of tough industrial installations, Hartzell fans have proved their efficiency, rugged reliability and long life. And these are the characteristics wide-awake management demands of its air moving equipment.

If you have an air-moving problem of any kind, Hartzell fans . . . and Hartzell engineering "know-how" . . . can solve it for you. But don't wait until a problem arises . . . get acquainted now with what Hartzell can do for you. Just mail the coupon below or call your nearby Hartzell field engineer.

**HARTZELL BELT-DRIVE DUCT FAN**

This fan is ideal for moving flammable fumes, corrosive elements or abrasive dust through a duct system. And it's as easy to install as a section of duct itself. Cast aluminum alloy propellers—single, two-propeller or multiblade models—12" to 60".



*The installation shown was handled by the Hartzell field office at 5717 Kirby Drive, Houston, Texas, phone KE-4565.*

**HARTZELL**

*propeller fan co.*

Div. of Castle Hills Corp.

*Please send me a copy of Bulletin A-109A showing Hartzell duct fans and other Hartzell air moving equipment.*

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Company _____

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City & State _____

If student, check here for special information ☐

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PROPELLER-TYPE FANS • BLOWERS
ROOF VENTILATORS • UNIT HEATERS

*ENGINEERING OFFICES IN PRINCIPAL CITIES*

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*Prepared*

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- **Sec. 3—Practical Design of Sand-Handling Ventilating Systems**
- **Sec. 4—Molding and Core Making Problems**
- **Sec. 5—General Principles for Melting and Pouring Operations**
- **Sec. 6—Cleaning Room**
- **Sec. 7—Housekeeping and Miscellaneous Control Measures**
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American General Investment Corp. Main and Richmond Sts., Houston, Texas. *Architect:* Wyatt C. Hedrick, Inc.

# WHY DID THIS HOUSTON FIRM SELECT G-E PACKAGED AIR CONDITIONERS?

## Six G-E units cool 20,000 sq. ft. . . . satisfy the individual cooling needs of five zones

Progressive firms like American General Investment Corporation are turning, more and more, to the modern, low-cost way to air condition a building. G-E Packaged Units have all the efficiency of central systems *plus* greater flexibility in meeting varied air conditioning requirements.

In American General Investment's new Houston office, the large office areas, the numerous small offices and the business machine room are divided into five zones. Six G-E units—one 5-ton, one 15-ton and four 10-ton, all located out-of-space—permit individual temperature and humidity control of each zone.

Thus, both the business machine room, which has a high internal heat load, and the normally less warm offices, are independently air conditioned—eliminating the problem of overcooling one zone in order to keep another zone comfortable.

Furthermore, since a G-E Packaged System is a *unit* system, just those zones are cooled in which people are working. Any unit may be taken out of operation at any time. And if a unit requires servicing, such as a periodic change of filter, it may be shut down without affecting the operation of other units. Write for data to: General Electric Co., Commercial and Industrial Air Conditioning Dept., Bloomfield, N. J.

***MORE ADVANTAGES WITH G-E PACKAGED AIR CONDITIONERS:***

- Low installation, low operating costs.
- Provide maximum design freedom in new construction and modernization. Floor models can be used in space or concealed. Ceiling-mounted models take no floor space —may be shelf-mounted.
- Streamlined cabinet styling.
- All models may be used singly or in multiple to meet any air conditioning need.
- Muggy Weather Control removes excess moisture in any weather without overchilling or clammy cooling.
- Built and assembled by G.E. Five-year warranty covers entire sealed cooling system.

Self-contained ceiling models—3 and 5 ton air-cooled—3, 5 and 7½ ton water-cooled.

Self-contained floor models—3, 5, 7½, 10 and 15 ton water-cooled.

**packaged AIR CONDITIONERS**

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

SO HALSTEAD & MITCHELL ENGINEERS SAID:

# "LET'S INCREASE FINNED SURFACE HEAT TRANSFER"

*Announcing* "TURBU-FLO"® *finned surface*

Increase turbulence of air flowing over a surface and heat transfer from that surface is increased. Develop a pattern on the surface which will build turbulence to a maximum *within the allowable pressure drop limits* . . . there you have the latest contribution from Halstead and Mitchell engineers . . . the new, exclusive "TURBU-FLO" finned surface!

"Turbu-Flo" assures you of extra-safe ratings for your manufactured equipment, because added heat transfer provides an unusual margin of *added* capacity.

"Turbu-Flo" is manufactured by ultra-modern equipment in our giant Zelienople plant to the exacting quality standards that have made Halstead and Mitchell products distinctive in the air-conditioning and refrigeration industry.

"Turbu-Flo" finned surface is *immediately available* to meet your every need.

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TELL US YOUR NEEDS . . .
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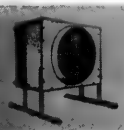
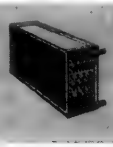

REMOTE AIR-COOLED CONDENSERS

BLAST HEATING AND COOLING COILS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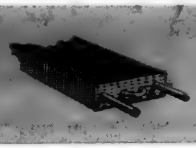
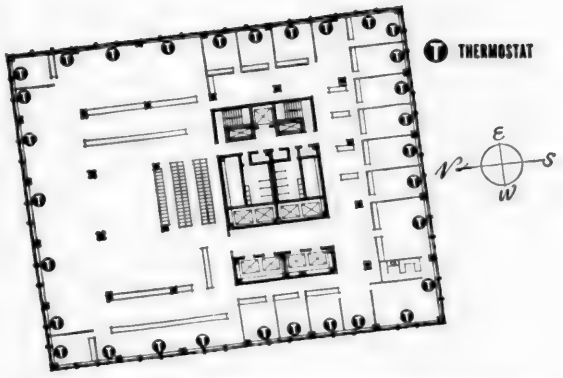

SPECIAL FINNED COILS FOR REFRIGERATION FIXTURES

*Honeywell Customized Temperature Control—a case history*

# How Honeywell helps give Denver's

*Mile High Center office building, Denver. Owners: Webb & Knapp and George A. Fuller Company. Architects: I. M. Pei & Associates; Kahn & Jacobs and G. Meredith Musick. Consulting engineers: Jaros, Baum & Bolles; Severud-Elstad-Krueger. General contractor: George A. Fuller Company. Prime mechanical contractor: Kerby Saunders, Inc. Plumbing and heating contractor: Crabb Plumbing & Heating Co. Electrical contractor: Fishback & Moore.*

**Remarkable sense of space** is present in outside offices such as this one, occupied by Webb & Knapp senior vice president, Arthur Rydstrom. Open effect is created by strip windows at floor level and larger glass panels above. Despite such free use of glass, comfort is constant. In offices tenants need only dial their choice of temperature; the Honeywell Customized Temperature Control installation then maintains it accurately and efficiently.




**Individual office temperature control** is indicated in this typical Mile High Center floor plan, showing Honeywell thermostat locations. Flexibility and quick response of the Honeywell Customized installation helps solve another problem, too. At Denver's elevation, one side of the building often needs heat while the other needs cooling. Electronic solar thermostats on the roof activate cooling according to changes in the direction of the sunlight striking the building.

# Mile High Center ideal comfort

*Tenants of imposing new office building may choose individual comfort preferences*

BUSINESS quarters completely modern in concept are provided by the new 23-story Mile High Center office building that dominates Denver's skyline.

Ideal indoor weather was assured by the building's planners. For they chose a Honeywell Customized Temperature Control installation to govern the year-round air conditioning system, giving tenants individual comfort control.

Adjoining the central structure is a three-level transportation building with a lower level concourse where shops and restaurants are located. Because of the flexibility of Honeywell controls, customized comfort is enjoyed throughout Mile High Center—from lofty offices to lower level shops.

That's what "customized" means—a control installation fitted to the needs of the building and its occupants, in heating, cooling, ventilating and humidity control.

True customized control can be provided only by Honeywell. Because only Honeywell manufactures all three types of controls—pneumatic, electric and electronic. Hence only Honeywell is in a position to make truly objective recommendations.

Whether it's an office building, factory, bank or store—any building of any size, new or existing—Honeywell Customized Temperature Control can help solve your clients' problems of heating, ventilating, air conditioning and industrial control.

For full details on Honeywell Customized Temperature Control, and the economical Periodic Maintenance Plan, call your local Honeywell office. Or write Honeywell, Dept. HV-5-65, Minneapolis 8, Minn.

MINNEAPOLIS
**Honeywell**

**Customized Temperature Control**

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DIVISION OF AMERICAN AIR FILTER
nelson
50
YEARS OF
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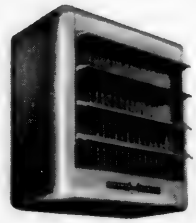
A Name Known For *Better Air*
throughout half a century

**OLD ENOUGH to have built a reputation for quality and dependability throughout half a century.**

**YOUNG ENOUGH to be continually in the foreground with the newest developments in heating, cooling and ventilation.**

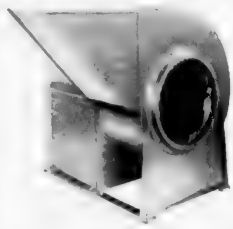
**BIG ENOUGH to offer one of the most complete lines in the industry, and a nation-wide service organization second to none.**

**SMALL ENOUGH to give every customer the prompt personal attention and service that his order requires.**



**HORIZONTAL UNIT HEATER**
Available in 18 sizes, designed for ceiling suspension and also to use either steam or hot water. Quiet operation; compact design. Catalog No. 700.

**INDUSTRIAL HEATER**
Replaces exhausted air, balances minus pressures. Big capacity—does the job of many smaller, propeller-type units. Catalog No. 750.



**UNIT BLOWER**
Years-ahead features in new "packaged" Unit Blowers. Compact, space-saving, easy to service. Wide range of unit sizes. Catalog No. 826.

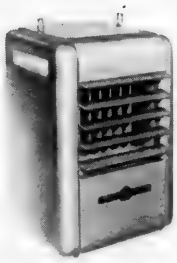
**A wealth of useful data now ready for you in the NEW HERMAN NELSON Catalogs**

New, modern format . . . easy-to-read engineering catalogs that are the finest in the industry are yours for the asking. Request catalogs you need on your business letterhead. Address American Air Filter Co., Inc., 294 Central Ave., Louisville 8, Ky.

# Heating and Ventilating Products

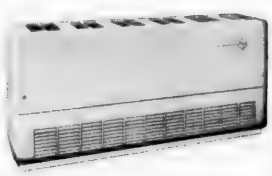
### VERTICAL UNIT HEATER

For high ceiling installations. Discharges air vertically downward or at angle to vertical in various directions. Steam or hot water. Catalog No. 700.



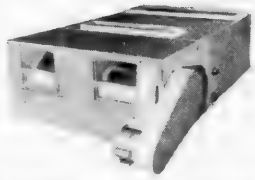
### GAS-FIRED UNIT HEATER

Job-rated for stores, lobbies, studios, warehouses, offices, salesrooms—*all* efficient heating. Available in seven different sizes. Catalog No. 715.



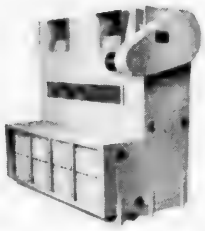
### CONSOLE HEATER

16 models—64 air inlet-outlet arrangements. Fully-recessed, semi-recessed or free-standing applications. Smartly designed. Catalog No. 727.



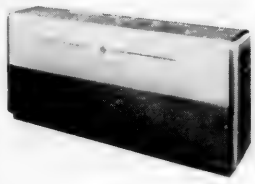
### HEATING & VENTILATING UNIT

Hangs on ceiling, out of the way, or mounts on wall or floor. Quiet operation, slow speed, with completely rotatable fan sections. Catalog No. 775.



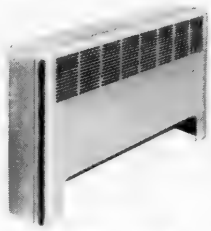
### AIR CONDITIONING UNIT

New type air-conditioning units for low cost commercial and industrial applications. Delivers up to 15,000 cu. ft. clean, cooled air per minute. Catalog No. 785.



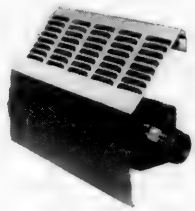
### CLASSROOM UNIT VENTILATOR

Functional, trim, clean lines—the modern version of the unit classroom heater and ventilator. Efficient, functional in design, attractive. Catalog No. 3500.



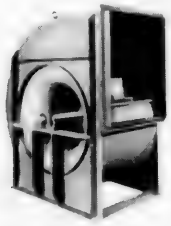
### CONVECTOR

Free standing or semi-recessed models in 4 depths and 3 or 4 heights. Can be furnished with dampers. Steam or hot water. Catalog No. 791.



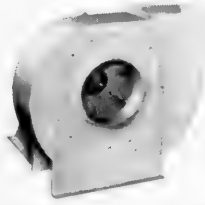
### FINNED RADIATION

Available either with steel fins on steel tubing or aluminum fins on copper tubing. Light-weight, suitable for exposed or concealed installation. Catalog No. 790.



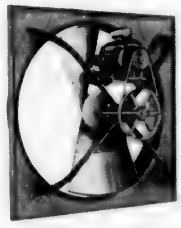
### CENTRIFUGAL FAN

Available in either slow speed or non-overloading types; 17 wheel diameters from 12¼" to 73"; 8 arrangements for direct or belt drive. Catalog No. 850.



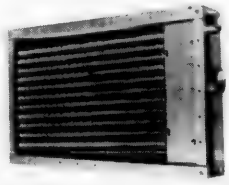
### INDUSTRIAL EXHAUSTER

Exclusive hub assembly cuts maintenance & replacement costs. New impeller design; heavy duty shaft & bearings. Catalog No. 860.



### PROPELLER FAN

Operates horizontally or vertically; belt or direct drive. Wide range of sizes in both types. Capacities to 36,150 CFM. Low operating cost. Catalog No. 800.



### AEROFIN COILS

A complete line of steam, hot water, chilled water, direct expansion and special duty coils. Catalog No. 49-NF.

***Better Air Is Our Business***

AAF herman nelson

**American Air Filter**
COMPANY, INC.

General Offices: Louisville, Kentucky

Plants in Louisville, Moline (Ill.), Morrison (Ill.), Chicago and Montreal (Canada)

# How to Select an Economical Temperature Regulator

First of all, what does economy mean where temperature regulators are concerned? In some industries it means improvement of product or reduction of spoilage through closer control of process temperatures. In others, it means the paring down of operating expense. The price of the regulator itself is a relatively small factor.

Today's buyers are shopping for:

1. Accuracy of control — not only when the regulator is new, but throughout its service life
2. Dependability — to prevent loss of production time
3. Minimum installation and maintenance cost

Here are a few tips on what to look for when you're installing a new or replacing an old temperature regulator —

**Packless construction** . . . and for this reason: A diaphragm operated, packless regulator minimizes friction. There are no closely fitted parts to stick or bind because of uneven expansion or collection of foreign matter. Also, there's less maintenance, since no repacking is ever required.

**A guarantee against wire drawing** of the seats and discs. Insist on it. This guarantee in combination with single seat design assures you of tight shutoff; you avoid expensive steam losses as well as loss of product in a process application.

**Broad control range.** In a standard regulator you should expect a control range of 100 F. And make sure the unit you select has a vapor tension thermostat that can take over-temperatures of at least 100 F.

**Easy maintenance.** Why ask for grief? Your temperature regulator should be basically simple in design so that it can be serviced by average plant personnel. All parts should be readily accessible for testing and cleaning.

**Double duty.** There's no point in buying a separate pressure regulator when you can select a temperature regulator that combines both temperature and pressure control within the same unit.

**Self-operating.** Make sure you get a regulator that operates on its own initial pressure. By doing so, you avoid the purchasing and maintenance of an air compressor plus air piping, and you're sure of uninterrupted operation during electric power failures.

• • • •

All of these points are important to you when it comes to selecting an economical temperature regulator. Perhaps you didn't realize you *could* expect so much. And perhaps you didn't realize that Spence Temperature Regulators offer all these features and more. May we send you our Bulletin T 500 containing further details? SE 130

**SPENCE ENGINEERING COMPANY, INC.**
*Walden, New York*

Get the jump on competition with . . .

It's a little like having aces wired, when a Copelaweld motor-compressor is a part of your packaged air conditioner. You've the comfortable feeling of being a step ahead of your competition.

The quiet purr of a Copelaweld delivers up to 10% more capacity than similar types . . . and at lower power consumption. The heavy-duty, high power factor motor combines valuable efficiency and operating economy.

Every Copelaweld feature is a selling point for your air conditioner. These are statements you will make with pride . . . sound, one-piece casting positively aligns motor and bearings . . . counter-balanced crankshaft for smoothness . . . positive lubrication from an oil pump with no moving parts . . . solid bronze rods and bearings for long life . . . Swedish steel valve reeds for precision compression control . . . compact to minimize space required.

Those are facts you'll use to build sales for your air conditioner when you use Copelaweld motor-compressors.

FREON-12 and FREON-22 MODELS AVAILABLE

½, ¾ and 1 H.P. models using Freon-12; ½, ¾, 1 and 1½ H.P. models using Freon-22. For larger capacities "Dual Copelaweld" systems offer such advantages as less cycling; lower starting current; flexibility . . . often at cost comparable to a single, larger motor-compressor.

*SEND FOR PERFORMANCE DATA AND COSTS*

*SINCE 1918*

**Copeland**
**REFRIGERATION CORPORATION, Sidney, Ohio**

# "Little brown church in the vale" ...*modern version*

## Heated radiantly with Steel Pipe

For this widely publicized community church, built for a total of only $67,000, steel pipe radiant panel heating fitted the budget and the heating requirements perfectly.

The simple beauty and dignity of an interior unmarred by exposed heating elements, and the all-purpose flexibility made possible by sliding walls, governed the selection of "invisible" radiant heating. The known economy and durability of steel pipe for heating made *it* first choice.

Yes, steel pipe has been proved in more than 60 years of hot water and steam heating applications. It still is the most widely used pipe in the world for radiant heating, snow melting, plumbing, fire sprinkler systems, structural applications, air, gas and water lines!

*Write for the free 48-page color booklet, "Radiant Panel Heating with Steel Pipe."*

Committee on
**STEEL PIPE RESEARCH**
AMERICAN IRON AND STEEL INSTITUTE
350 FIFTH AVENUE, NEW YORK 1, N.Y.

Steel Pipe is First Choice

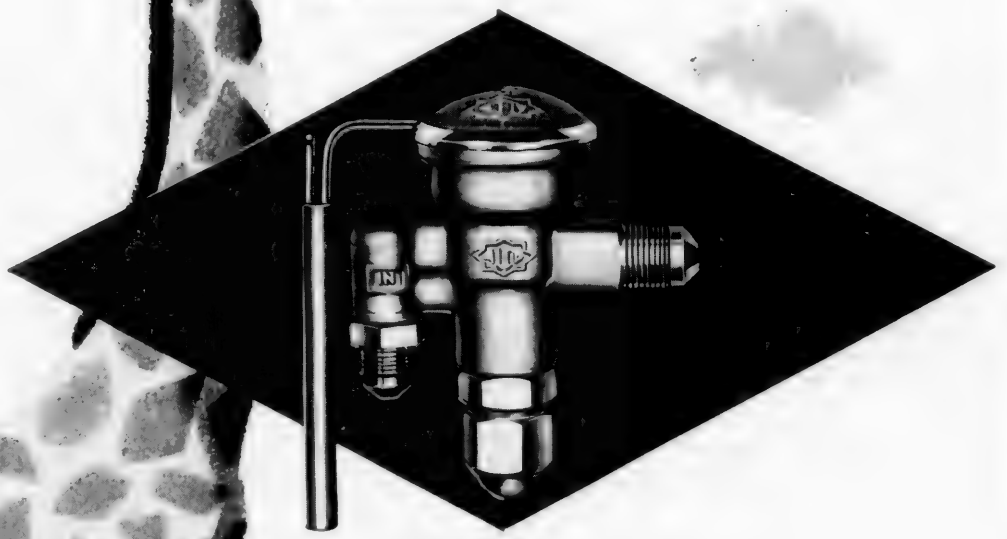
# for hard-to-reach spots

## ALCO 402

**the small-fixture Thermo Valve**

Prevents motor overload.

May be installed in any position—
even upside down—
in or out of the refrigerated area.
It's liquid charged.



choose from these convenient sizes:

Freon–12—¼, ½ and 1 ton
Freon–22—.4, .8 and 1.6 tons
Methyl-Chloride—½, 1 and 2 tons

**ALCO 402 ENGINEERED FOR SERVICE ENGINEERS**

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Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

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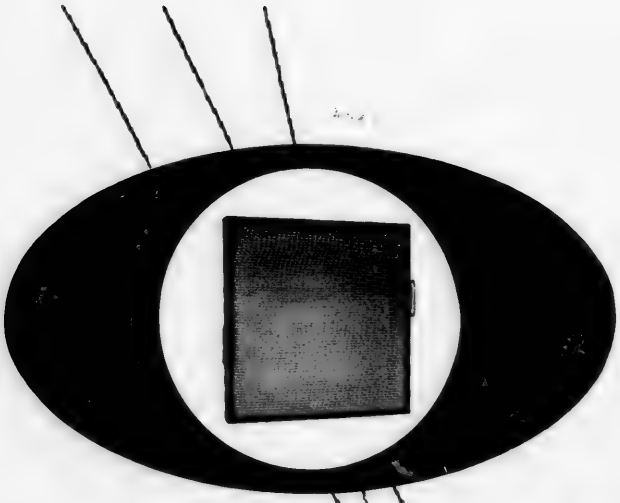


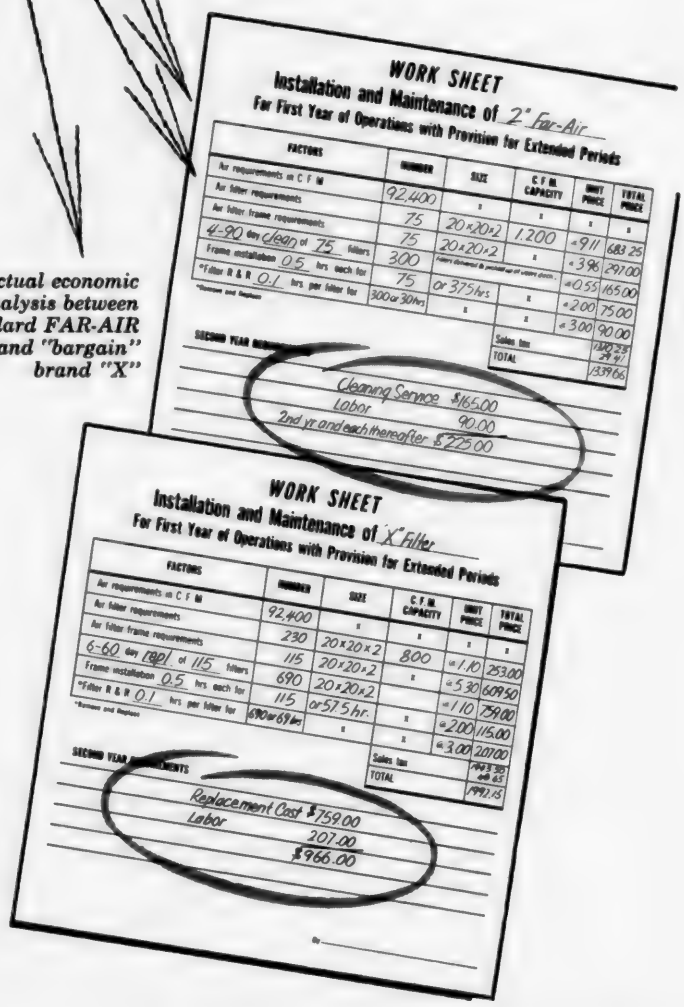
# NOW—
## you can be sure you are right

Because most filters are efficient at cleaning air, you are reasonably sure of getting a satisfactory job when you install an established make. The service life of your expensive air conditioning machinery and the comfort of your building depend on the ability of relatively low cost filters to do their job.

FARR Company, as one of the country's leading filter manufacturers, wants to insure that your are getting the most value out of your present filters, regardless of make. Therefore, they will send a field engineer who is an air filtration expert, to carefully analyze your air filters and submit a factual, written report like the one shown, on his findings. Often he can make suggestions that will greatly increase your filtration efficiency and save a substantial amount of money in operating costs.

FARR Company is making this service available to you on a no cost basis because it will increase your appreciation for the function of the often-neglected air filters. It will point out the importance of buying standard brand filters. It will in some cases result in sales for FAR-AIR filters . . . and that is important, too.

Why not try this service? It is factual, honest and subject to favorable comparison by any reputable manufacturer. Write today to Farr Company, P.O. Box 45187, Airport Station, Los Angeles 45, Calif.


WORK SHEET
Installation and Maintenance of 2" Far-Air
For First Year of Operations with Provision for Extended Periods
FACTORS
NUMBER
SIZE
C.F.M. CAPACITY
UNIT PRICE
TOTAL PRICE
Air requirements in C.F.M. 92,400
Air filter requirements 75 20×20×2 1,200 @.911 683.25
Air filter frame requirements 75 20×20×2 @.398 29.700
4-90 day clean of 75 filters 300 @.055 165.00
Frame installation 0.5 hrs. each for 75 @2.00 75.00
*Filter R & R 0.1 hrs. per filter for 300 or 30 hrs. or 3.75 hrs @3.00 90.00
Sales tax 1003.25
TOTAL 1339.66
Cleaning Service $165.00
Labor 90.00
2nd yr. and each thereafter $225.00
WORK SHEET
Installation and Maintenance of "X" Filter
For First Year of Operations with Provision for Extended Periods
Air requirements in C.F.M. 92,400
Air filter requirements 230 20×20×2 800 @1.10 253.00
Air filter frame requirements 115 20×20×2 @5.30 609.50
6-60 day repl of 115 filters 690 20×20×2 @1.10 759.00
Frame installation 0.5 hrs. each for 115 or 57.5 hr. @2.00 115.00
*Filter R & R 0.1 hrs. per filter for 690 or 69 hrs @3.00 207.00
Sales tax 493.30
TOTAL 1992.15
Replacement Cost $759.00
Labor 207.00
$966.00

*An actual economic analysis between standard FAR-AIR filters and "bargain" brand "X"*

FARR COMPANY
NO COMPROMISE ON QUALITY
*Los Angeles, New York, Chicago*
*New Orleans*

# Another great Detroit Stoker.....

## MOST IMPORTANT DEVELOPMENT IN COAL BURNING SINCE INTRODUCTION OF THE DETROIT ROTOGRATE

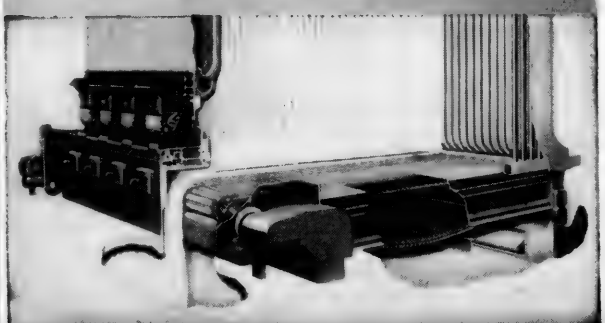
## Detroit RotoStoker Type C-C

(CONTINUOUS CLEANING)

**Detroit RotoStoker Type C-C discharges ash continuously at the front.**

**Detroit RotoStoker Type C-C (Continuous Cleaning)**

**Detroit RotoGrate Stoker—Traveling Grate Spreader Stoker**



Users of medium and small size steam generators may now have the long proven advantages of continuous ash discharge spreader stoker firing with the Detroit RotoStoker Type C-C.

### CHECK THESE ADVANTAGES:

- Cleans Fuel Bed and Discharges Ash Continuously at the front.
- Smokeless Operation Through a Wide Load Range
- Efficiently Burns Bituminous Coals a d Lignite.
- Insures Continuous Uninterrupted Steaming Capacity and High Availability.
- Responds quickly to Fluctuating Loads
- Fuel Feeders Handle High Moisture Coals Easily and Without Clogging
- Operation Automatic and Dependable
- Easily Applied to Existing Boilers—No Basement Necessary
- Design results in Low Maintenance
- Many Sizes Available to Develop from Approximately 5,000 to 75,000 Pounds of Steam Per Hour

For large steam generators Detroit RotoGrate Stokers have proven their merit for more than fifteen years. The *first* and *foremost* traveling grate spreader stoker, the Detroit RotoGrate Stoker was first to establish the tremendous advantages of continuous ash discharge, spreader stoker firing.

# DETROIT STOKER COMPANY

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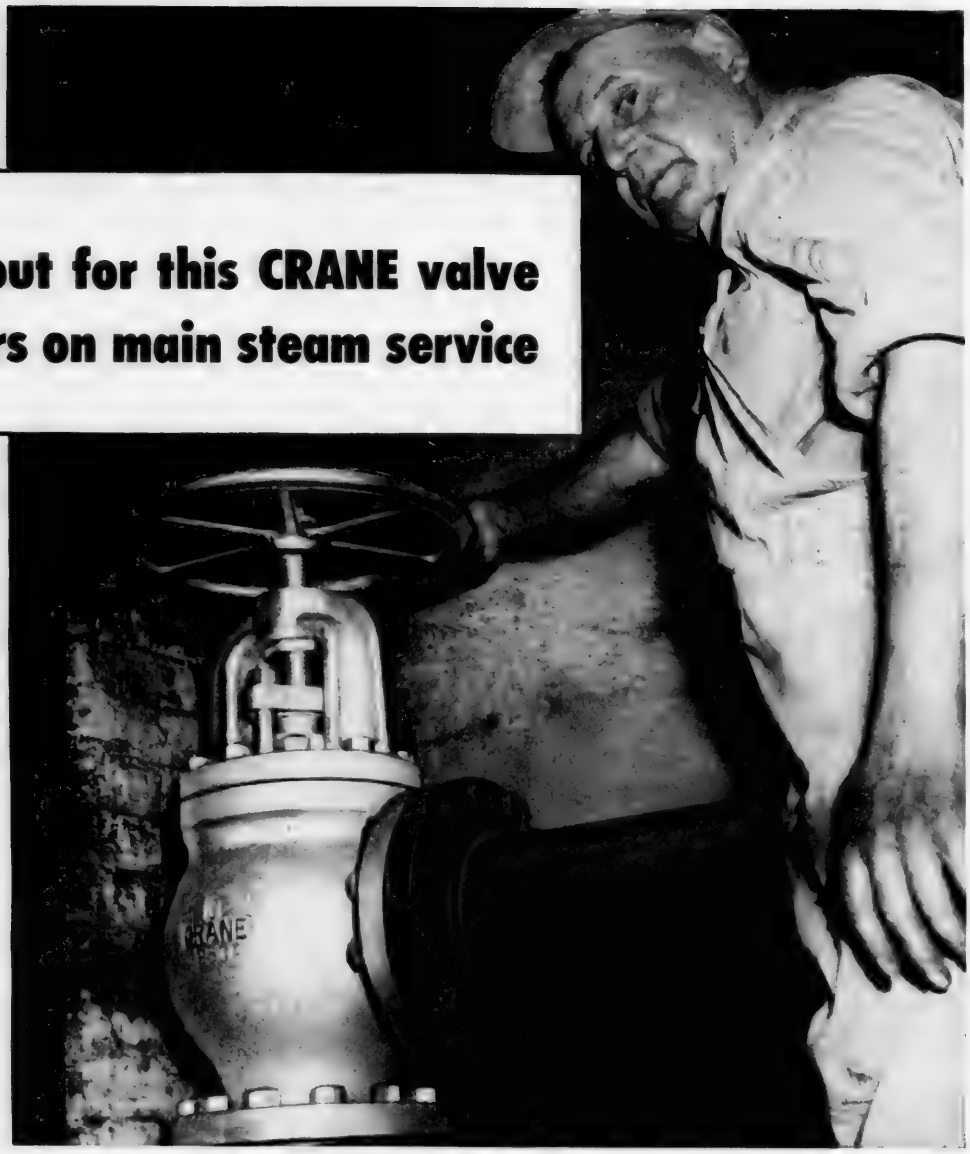
# No time out for this CRANE valve in 40 years on main steam service




**THE CASE HISTORY**—Two Crane 250-pound iron body angle valves—6-inch (shown) and 5-inch size—scored this exceptional service record.

They were installed in 1915 on the main steam leads from boilers in the plant at Delavan, Wis., now occupied by The George W. Borg Corporation. In 40 years' uninterrupted service these Crane valves never failed to operate properly nor caused a shutdown. With but routine maintenance, they opened fully and were seated tight with ease under infrequent operation. Working pressure of boilers was originally 150 psi.—later reduced to 75 psi. This year, both valves were retired. The new replacements are Crane quality valves, of course.

Crane iron valves in particular need no introduction to thrifty buyers. In all grades, Crane iron castings generously exceed the requirements of equivalent A.S.T.M. specifications. Crane Ferrosteel, for instance, used in 250-pound valves is 35% stronger than ordinary cast iron.

In any pressure class, you'll find Crane quality outstanding. Choose from complete lines of gates, globes, angles and checks.

Your Crane Representative can give valuable help in specifying and ordering.

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**PIPE • KITCHENS • PLUMBING • HEATING**

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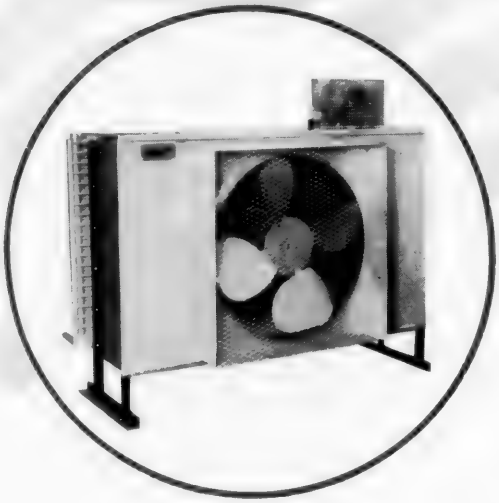
# NEW 'BC' UNITS EXTEND RANGE OF BUSH AIR COOLED CONDENSERS to 20 TONS...



**NEW** Bush 'BC' Blower Condensers permit air conditioning and refrigeration systems to operate *without water* . . . provide the answer to excessive water costs, limited supply, excessive impurities or disposal problems.

Available in capacities up to the 20 Tons, new Bush 'BC' Blower Condensers feature *low noise level . . . quiet operation.*

Patented Inner-Fin coil construction, *a Bush exclusive,* makes these the most compact units on the market. Units are easy to install, have rugged all-steel cases with durable rust-resistant finish . . . are available arranged with either blower fan or propeller fan.

The BUSH line of water-savers, most complete in the industry, also includes:

**'CDT' COPPER DECK COOLING TOWERS** with all copper decking. **'IEC' INNER-FIN EVAPORATIVE CONDENSERS** featuring patented inner-fin coils. Both units available with blower or propeller fan. Capacities from 3 to 90 Tons.

**'PFC' PROPELLER FAN CONDENSERS** — Two basic models, 2.2 Tons and 3.3 Tons can be combined by mounting in banks to obtain any desired tonnage.

**'PS' PRESSURE STABILIZERS** — automatically maintain satisfactory head pressure when air cooled condensers operate outside in low ambient temperatures.

Write direct for complete information or contact your experienced BUSH representative for valuable engineering and application assistance.

**BUSH MANUFACTURING COMPANY • West Hartford 10, Conn.**

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Type RK. Integral sizes through 5 hp.

# choose these smaller, lighter, motors... for modern equipment

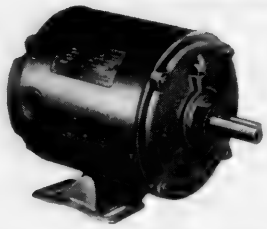
For years Wagner motors have been the first choice of many leading manufacturers of air conditioners, refrigerators, freezers, water pumps and motor-driven tools. They meet the requirements of many other similar applications because of their high starting torque and low starting current.

Now these Wagner motors are lighter in weight and smaller in size. This means that you can design smaller motor housings—build lighter motor mountings. Wagner motors are easier to handle and easier to stock because they take up less space.

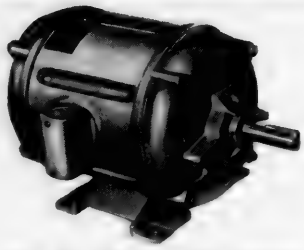
And these motors offer low maintenance costs—only a minimum of servicing is required—they give many years of reliable service with unusual freedom from vibration and noise.

Available in repulsion-start or capacitor-start types —open or totally-enclosed—sleeve or ball bearing— with rigid or resilient bases or machined endplates for flange mounting. Write today for Bulletin MU-185 which gives complete information.

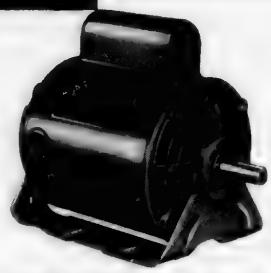
## A Complete Line—Single-phase and Polyphase Motors



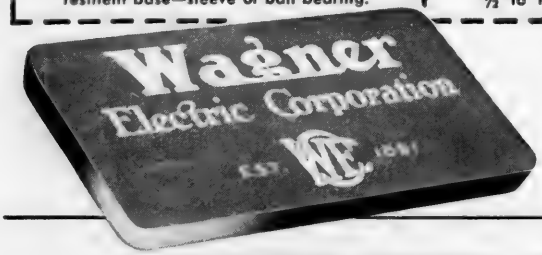
Type RP, Polyphase fractional horsepower motors. Available in ⅛, ¼, ⅓, ½, and ¾ hp ratings. Rigid or resilient base—sleeve or ball bearing.



Type RA, Repulsion-start induction-run single-phase motors. For applications requiring high starting torque. ½ to 15 hp.



Type RK Capacitor-start. ⅓, ½, and ¾ hp . . . sleeve or ball bearings. The resilient mounting offers unusual freedom from vibration and noise.

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M56-5

# JENKINS PRACTICAL PIPING LAYOUTS

77

| Code | Quan. | Jenkins Valve | Service |
|---|---|---|---|
| A | 1 | Fig. 677A Br. Gate | Cold water well shutoff valve |
| B | 2 | Fig. 295 Br. Sw. Check | Prevent backflow thru well pumps |
| C | 1 | Fig. 677A Br. Gate | Warm water well shutoff valve |
| D | 6 | Fig. 368 Br. Gate | Circ. pump shutoff valves |
| E | 1 | Fig. 106A Br. Globe | Settling Tank drain valve |
| F | 1 | Fig. 368 Br. Gate | Shutoff discharge to warm water well |
| G | 1 | Fig. 368 Br. Gate | Control water to evaporator |
| H | 1 | Fig. 368 Br. Gate | Control water to condenser |
| J | 1 | Fig. 368 Br. Gate | Control water to warm water well |
| K | 1 | Fig. 368 Br. Gate | Control water to ch. water pump |
| L | 1 | Fig. 106A Br. Globe | Constant head regulator bypass |
| M | 2 | Fig. 368 Br. Gate | Constant head regulator shutoff |
| N | 2 | Fig. 352 Br. Sw. Ch. | Prevent backflow thru circ. pumps |
| P | 2 | Fig. 368 Br. Gate | Ch. water temp. regulator shutoff |
| R | 1 | Fig. 106A Br. Globe | Ch. water temp. regulator bypass |
| S | 2 | Fig. 368 Br. Gate | Evaporator shutoff |
| T | 1 | Fig. 352 Br. Sw. Check | Prevent backflow thru evaporator |
| U | 1 | Fig. 368 Br. Gate | Shutoff water to recovery & precon coil |
| V | 1 | Fig. 368 Br. Gate | Shutoff discharge to cold water well |
| W | 1 | Fig. 368 Br. Gate | Control water to hot water pump |
| X | 1 | Fig. 368 Br. Gate | Shutoff water to heating coil |
| Y | 1 | Fig. 368 Br. Gate | Control water to hot water pump |
| Z | 1 | Fig. 368 Br. Gate | Control water to ch. water pump |
| AA | 1 | Fig. 368 Br. Gate | Control water to warm water well |
| BB | 2 | Fig. 368 Br. Gate | Condenser shutoff |
| CC | 1 | Fig. 47 Br. Gate | Expansion tank shutoff valve |
| DD | 1 | Fig. 47 Br. Gate | Expansion tank shutoff valve |
| EE | 1 | Fig. 47 Br. Gate | Control makeup to expansion tank |
| FF | 1 | Fig. 92 Br. Sw. Check | Prevent backflow to water lines |
| GG | 5 | Fig. 106A Br. Globe | Drain valves |

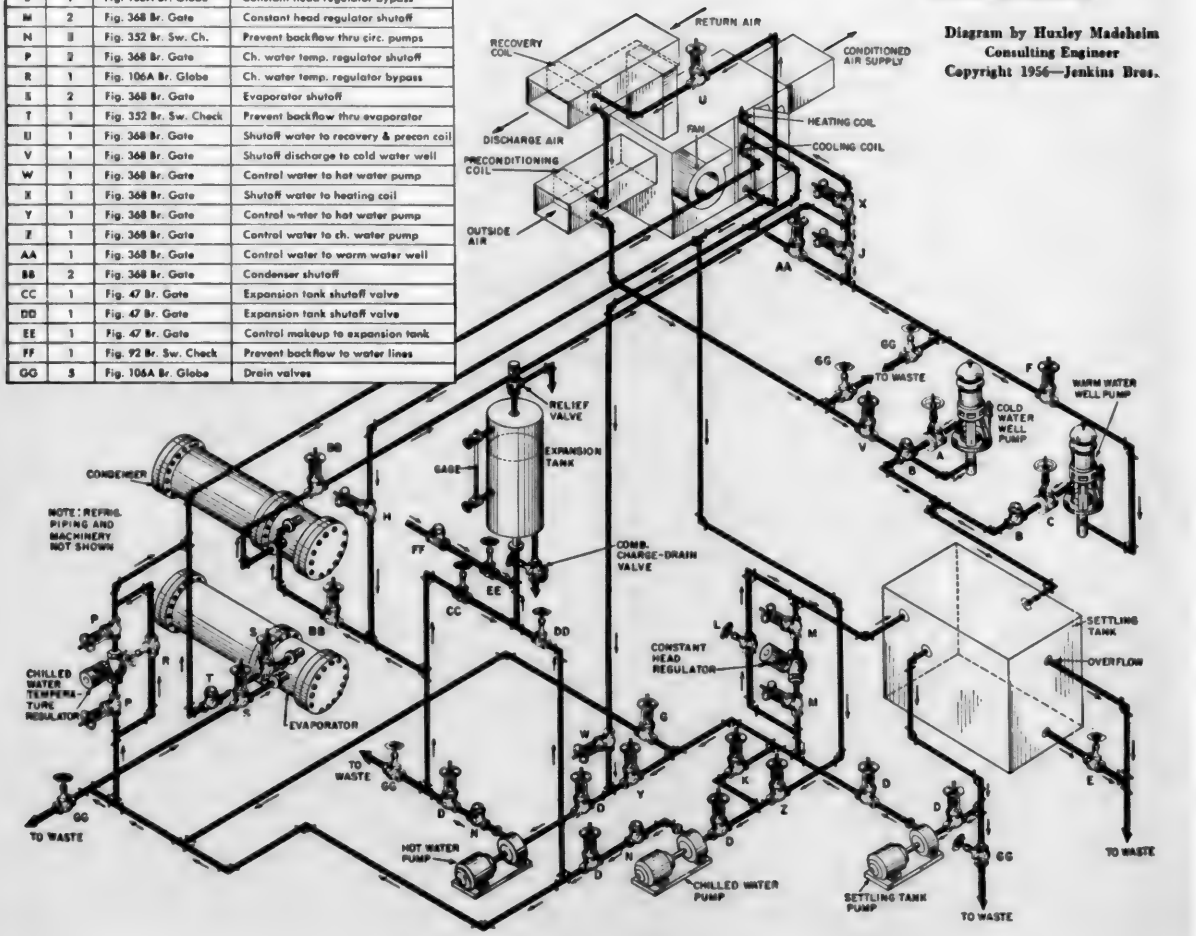


Diagram by Huxley Madeheim
Consulting Engineer
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## *How to plan piping connections for all-year*

## AIR CONDITIONING WITH THE HEAT PUMP

**Well water is used** in the basic heat pump installation illustrated. Such a system could readily serve a building with several exterior and interior zones, which would have many air handling units. For simplicity, only one unit is shown in the diagram.

**For heating demands,** this system provides a closed circuit consisting of hot water pump, condenser, and heating coil. For cooling, a second closed circuit consists of chilled water pump, evaporator, and cooling coil.

**During the heating season,** water is supplied to the settling tank from the warm water well (about 60° F). It is circulated by the chilled water pump to the evaporator, and then to the cooling coil to provide cooling, where needed, for interior areas. The water then flows to the recovery coil, picks up heat from waste air and carries it to preconditioning coil, where it is used to preheat outside air. The resulting chilled water is discharged to the cold water well.

**During the intermediate seasons,** water is supplied to the settling tank from the cold water well (about 50° F). It is circulated by the hot water pump to the condenser, and then to the heating coil to provide heat, where needed, for the exterior zones. The water is then discharged to the hot water well.

**During the cooling season,** water from the cold water well is pumped to the settling tank, and then circulated to the evaporator and the cooling coils. It is next used to cool the condenser, and is then discharged to the hot water well. If the demand for cooling is low, and the well water cold enough, the evaporator may be bypassed.

Consultation with accredited piping engineers and contractors is recommended when planning major piping installations.

**Enlarged diagram** and full description of this layout free on request. Ask for Layout No. 77. Jenkins Bros., 100 Park Ave., New York 17.

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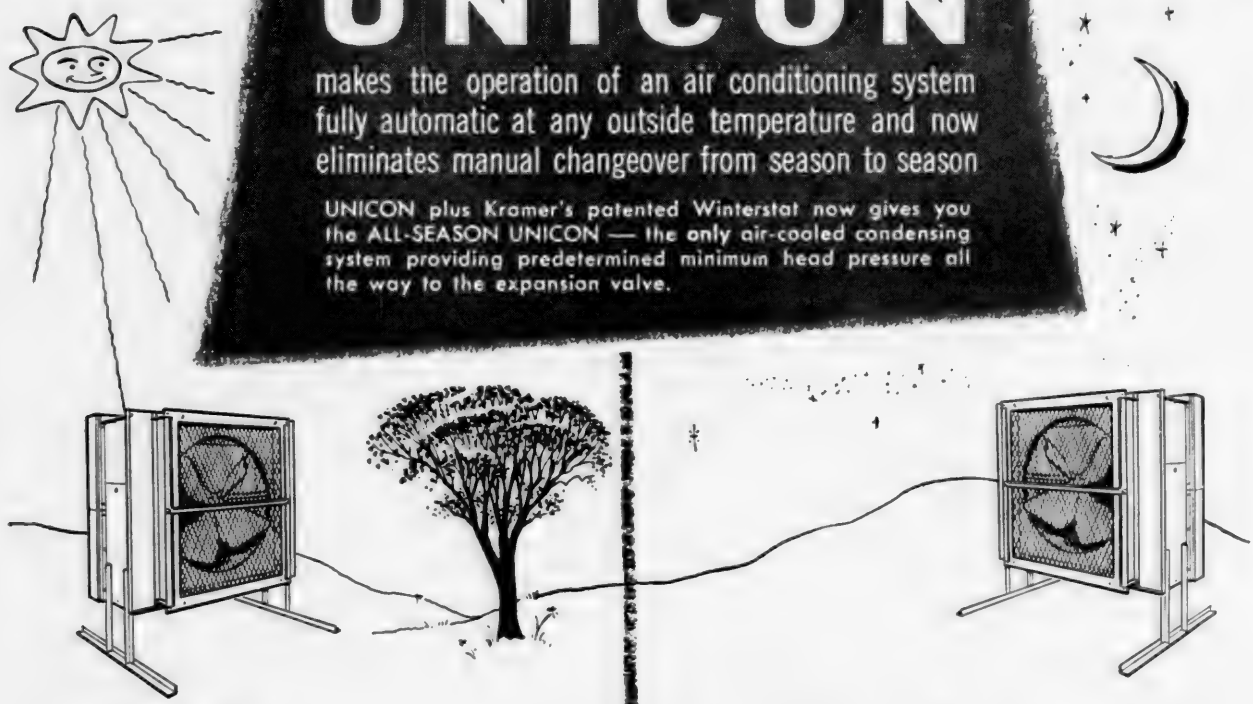
makes the operation of an air conditioning system fully automatic at any outside temperature and now eliminates manual changeover from season to season

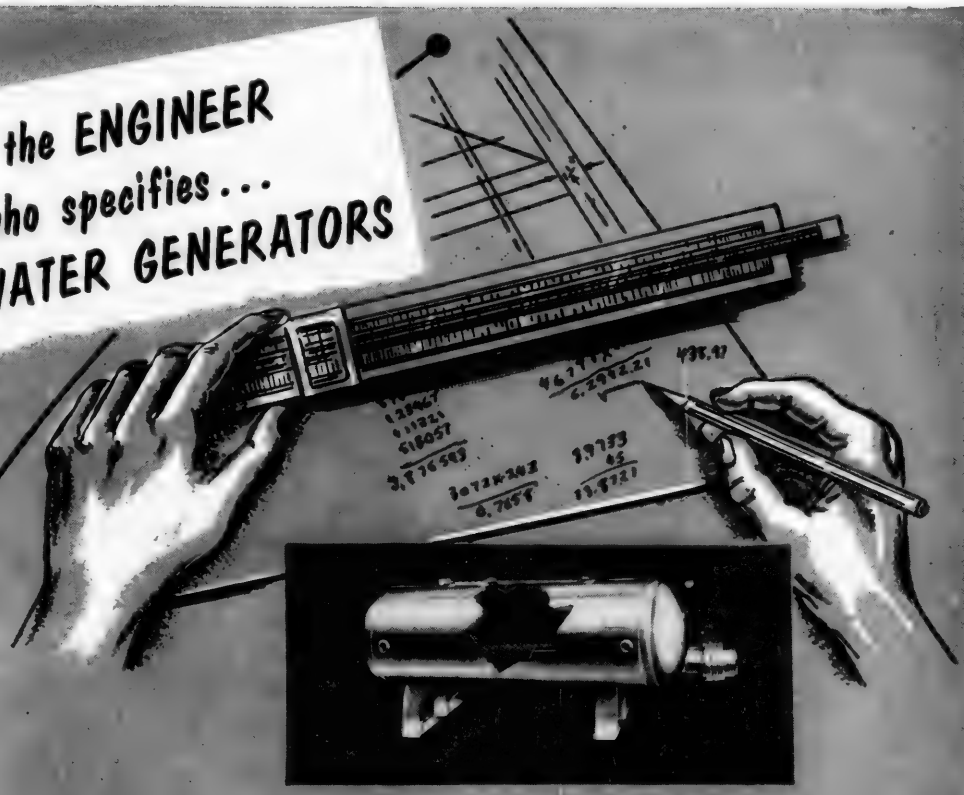
UNICON plus Kramer's patented Winterstat now gives you the ALL-SEASON UNICON — the only air-cooled condensing system providing predetermined minimum head pressure all the way to the expansion valve.



High Noon. . . or cool of evening

KRAMER TRENTON CO. • Trenton 5, N.J.

To the ENGINEER
who specifies...
HOT WATER GENERATORS



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The life and satisfaction of a Hot Water Generator depends on three factors; 1) proper sizing of vessel, 2) proper sizing of heating element and source of heat, 3) reducing corrosion to a minimum. Incorrectly calculating any of these factors might make early replacement of the unit necessary.

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When specifying Hot Water Generators, Heat Exchangers, Air Receivers, Storage Vessels and Novelon Linings, let NOVELTY'S Engineering and Sales Departments help you specify the correct vessel to meet your needs. Let our 50 years of experience be your assurance that the vessel you specify is the best, most advanced vessel available.

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STORAGE TANKS

SPECIAL LININGS

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• Commerce Courts Building, Commerce Ct. and Raymond Blvd., Newark, N. J. Architect and Engineer: Henry Boyer.

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After applying an adhesive to the panel, the pre-cut Pittsburgh Fiber Glass insulation is easily slipped into place. Half-inch Superfine with a .0007 aluminum facing is being used.

Here, ½" Pittsburgh Superfine is being fitted to a panel for an air conditioner. Note how flexible it is.

## "We choose Pittsburgh Fiber Glass Insulation because of its consistent specifications and roll-after-roll dependability"

HALL-NEAL FURNACE CO., INDIANAPOLIS, IND.

"An insulating material must be many things," says Robert A. Hoyt, Production Manager at Hall-Neal, "but above all, it must be consistent throughout the roll. Insulation with fibers in varying densities causes 'hot spots' which result in discolored casing, heat loss, and higher fuel bills.

"After trying other types of insulation, we made a 100% change to Pittsburgh Superfine Fiber Glass because of excellent quality and service, close engineering cooperation, realistic price, and fast, dependable delivery."

If you manufacture or install furnaces, air conditioners, or related ductwork, you'll want to know how Pittsburgh Plate Glass Company's Superfine Fiber Glass insulation can exactly meet your insulating requirements. For complete information, write for Bulletins F-100, F-185 and F-190. Address your inquiries to the Fiber Glass Division, Pittsburgh Plate Glass Company, One Gateway Center, Pittsburgh 22, Pennsylvania. Or, for quick service on your specific problem, call the nearest Pittsburgh Fiber Glass Sales Office listed below.

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Sales Offices are located in the following cities: Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, and St. Louis

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1 CURTIS has 102 years of experience in manufacturing precision made equipment. One of the first manufacturers of packaged air conditioning units—since 1936.

2 Unsurpassed know-how for building air conditioning units that operate longer with less maintenance and service—YET ARE COMPETITIVELY PRICED with generous profit margin for you.

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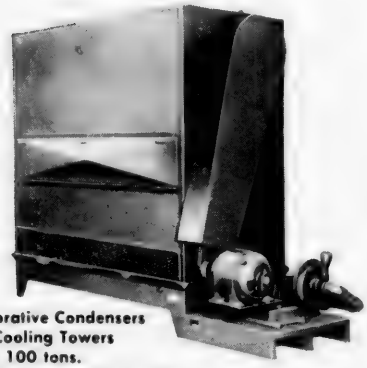
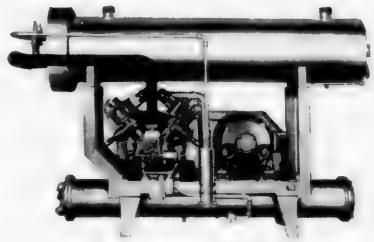
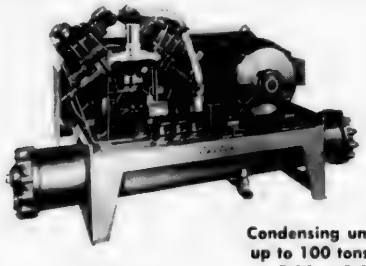


Evaporative Condensers and Cooling Towers up to 100 tons. Air handling units to match.

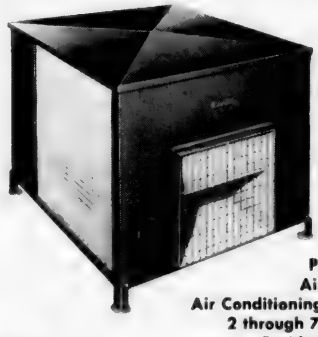
Packaged units in a rainbow of colors— a CURTIS exclusive. 3 through 50 tons.



Packaged Liquid Chillers— 7½ to 100 tons—F-12 or F-22. With room console units to provide controlled cooling and heating without duct work.



Condensing units up to 100 tons— F-12 or F-22.



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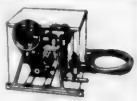
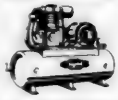


CAR WASHERS



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# PRODUCT APPLICATIONS

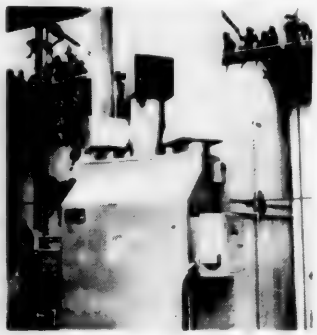
## New, Unusual, or Ingenious Uses of Equipment and Materials

**Conducted by WM. B. FOXHALL, Associate Editor**

### Monkeys Enjoy Industrial Heater

**PROBLEM:** The Melbourne Zoological Gardens in Australia was faced with the problem of housing and acclimatizing 2,000 monkeys flown in from Malaya to be used for development of polio vaccine.

**SOLUTION:** Two industrial forced air space heaters, designed by Dravo Corp. of Pittsburgh, and manufactured under license by Crockford & Robertson, Autstralian air control engineers, were installed to provide a year-round temperature of not less than 70 deg F and at the same time to provide up to six complete air changes per hour, depending upon the number of monkeys confined in the cages at any one time. Heaters are oil fired and supplied from underground storage tanks. Design heat loss of the compound is estimated at 750,000 Btu per hr and heaters are designed to bring in outside air at the rate of about 11,000 cfm.



**RESULTS:** Monkeys are maintained in good health and are acclimatized for handling by vaccine laboratories.

### Remote Units Cool Medical Center

**PROBLEM:** A cooling load of 120 tons was to be handled by equipment occupying only 8 x 8 ft of floor space at the new Medical Center, Springfield, Mass.

**SOLUTION:** Simons Burner and Petroleum Co., heating and air conditioning contractor on the job, utilized 4 thirty-ton Heat-X Inner-Fin chillers, 2 sixty ton Westinghouse compressors and 4 thirty ton Heat-X Inner-Fin heat interchangers to handle the load. Chilled water at 44 deg F is introduced into the system and a temperature rise of approximately 8 deg occurs during circulation. Installed throughout office areas of the new building are 240 Bush CR remote air conditioning units, product of Bush Manufacturing Co., Hartford, Conn., which permit in-the-room temperature control to suit each occupant's preference. Hot or chilled water circulated through the units from the central source provides heating or cooling medium. Interior zone conditioning of waiting rooms, corridors, etc., is accomplished by four Bush air handling units, two of the floor-mounted vertical type and two ceiling-hung horizontal models.

**RESULTS:** The contractor reports that the procedure he followed of installing individual remote air conditioning units provided building management with an early occupancy advantage. Units could be ordered and delivered while the building was still under construction without impairing the flexibility of office arrangement. Location of partitions, for example, did not pose the problem that would have existed with a central station system. Space was actually being rented while the building was still under construction. Architect for the new structure was Louis C. Hinckley, and E. J. Pinney Co., Springfield was the General Contractor.

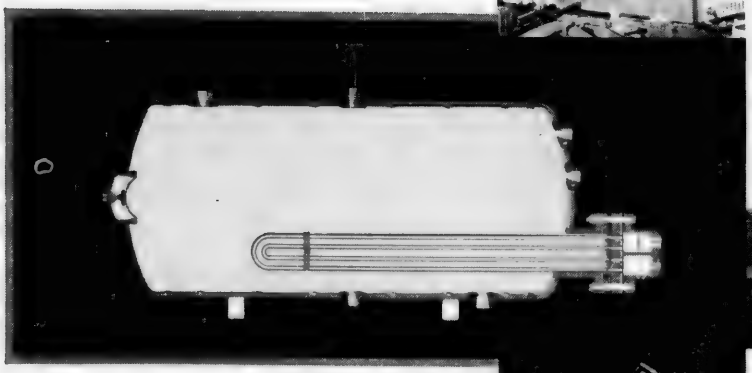
### Plastic Pipe Serves Plating Operation

**PROBLEM:** At the Hagerstown, Ind., plant of the Perfect Circle Corp., piston ring manufacturers, chromium plating operations were beset by repeated interruptions for the replacement of pipe corroded by the action of chromic acid plating solutions.

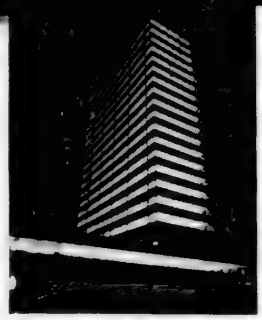
**SOLUTION:** The engineering staff of Perfect Circle studied the problem prior to construction of a new $50,000 chromic acid recovery and purification facility at the plant. It was decided to specify polyvinyl chloride (PVC) plastic piping with fittings made by Tube Turns Plastics, Inc. Laboratory and field tests had indicated that this material would withstand action of the solutions better than other materials of comparable price. Plastic pipelines were installed in the deionizer used to treat water for the process. Other plastic pipelines served the dilution and processing tanks for chromic and sulphuric acids. Drainage systems are also equipped with plastic pipes. Operating pressures are from 25 to 75 psi and temperatures range from 50 to 90 deg F.

**RESULTS:** Scale commonly found in metal lines is not present in plastic lines. Hazards to personnel and equipment caused by leakage due to corrosion have been avoided. The PVC piping shows no signs of deterioration although metal piping systems would have had to be replaced at relatively short intervals. Painting and maintenance is held to a minimum. Installation of piping was relatively easy. Electrical resistance of PVC piping is an advantage in plating operations.

**Dallas: Republic National Bank Building.** *Architects:* Harrison & Abramovitz; Gill & Harrell. *General Contractor:* J. W. Bateson Company, Inc. *Consulting Engineers:* Jaros, Baum & Bolles. *Mech. Contractor:* Farwell Company, Inc.



**Denver: Mile High Center.** *Architects:* I. M. Pei and Associates. *Associated Architect:* G. Meredith Musick. *Contractor:* George A. Fuller Company. *Consulting Engineers:* Jaros, Baum & Bolles. *Mechanical Contractor:* Kerby Saunders, Inc.



**New York: Lever House.** *Architects:* Skidmore, Owings & Merrill. *Contractor:* George A. Fuller Company. *Consulting Engineers:* Jaros, Baum & Bolles. *Mechanical Contractor:* Kerby Saunders, Inc. *Plumbing Contractor:* Gillman-Rous-Pesce Corp.

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These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

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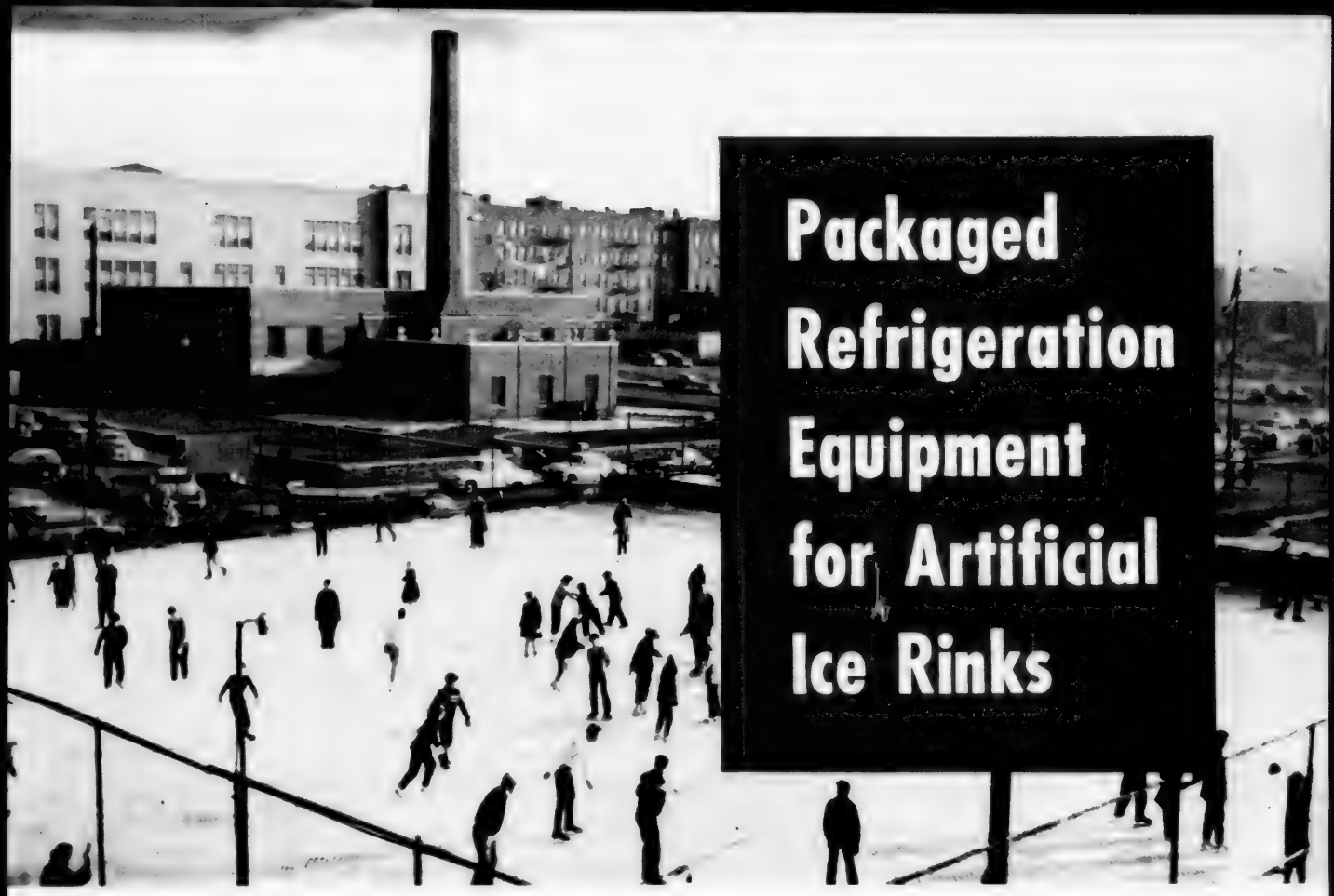

# Packaged Refrigeration Equipment for Artificial Ice Rinks

W. G. WASSMANDORF

The Trane Company, La Crosse, Wis.

**Increased interest and participation in ice skating, hockey and curling is creating a boom in the construction of ice skating rinks. Packaged equipment may add the flexibility and economy required to implement this growing interest.**

MORE than 700 U. S. cities are now operating 3,474 skating areas. The 1955 World Ice Skating Guide reports that last year the attendance at artificial ice rinks in the U. S. was about 30,000,000. Traveling ice shows, movies and TV programs have activated new armies of skating fans who, in 1955, spent approximately 10 million dollars for ice skates compared with about half that amount in 1947. Schools and country clubs across the nation are adding rinks to extend activities through the winter months. The ancient Scottish ice game of curling, which has 175,000 players in Canada, already boasts over 7,500 active participants in the United States. (See Fig. 1.)

Fig. 1. Curling is gaining in popularity in Canada and the U.S.

Unfortunately, while this upsurge of interest in ice skating and curling has been taking place, the weather has been most uncooperative. The number of skating days during the past few winters has not been sufficient to satisfy the ice lovers' appetites. This situation is causing a boom in the construction of artificial ice rinks where participants can enjoy all-season skating, hockey and curling.

## Artificial Ice Rinks

Artificial ice rinks can be constructed indoors or outdoors, and can be either permanent or portable. Leading

**Werner George Wassmandorf is manager of the reciprocating compressor sales department of The Trane Company. Mr. Wassmandorf came to The Trane Company in 1952 after spending a number of years as a sales representative for Brunner Manufacturing Co. and as a sales engineer for General Electric. He received his degree in mechanical engineering from the University of Michigan. Mr. Wassmandorf is also the author of several additional technical articles. Among these is the article entitled, "Capacity Control for Compressors", which appeared in the December, 1954 issue of AIR CONDITIONING, HEATING AND VENTILATING.**

the boom in artificial ice rink building are municipalities. Most of their new rinks are of the outdoor type, many of portable or roll-up construction with the refrigeration equipment sometimes mounted permanently in trucks or trailers.

The ideal sizes (larger than regulation) for specific types of rinks are: hockey, 85 by 200 ft; curling, 14 by 146 ft per sheet; public skating, about 30 sq ft per person; fancy skating, adequate to include the desired number of 18 ft diameter patches. Hockey players and curlers like a hard dry ice, public skaters prefer a softer damp ice, while figure skaters usually want something in between. The thickness of the ice sheet varies from ½ inch to about 2 inches.

To provide a uniformly frozen ice surface for these rinks it is necessary to circulate a low temperature solution, usually calcium chloride brine, through pipe coils which are installed beneath the skating surface. These coils may be installed permanently in a reinforced concrete slab; semi-permanently in sand or crushed stone; or temporarily on top of the ground, floor or court. Standard mild steel or wrought iron pipe, 1 or 1¼ inches in diameter is commonly used (Fig. 2); however, polythylene plastic pipe is proving to be quite satisfactory, particularly for roll-up type rinks.

Whichever pipe is used, it should be laid out in parallel so the brine makes only one or two passes. If the pipe run is from 190 to 380 feet in length, only one pass is normally used. In this case the supply and return headers are placed on opposite sides of the rink. For shorter runs the pipe is doubled back to make two passes. Both headers are then installed on the same side of the rink. Normally the coil pipes are placed on 4 to 4½-inch centers. Wider spacing is not recommended because it may cause an unsatisfactorily slow freezing rate or a furrowed ice surface.

## Cooling Load Calculations

Information for calculating the entire cooling load can be obtained from the ASRE Data Book, 1954-55 Applications editions. This information includes recommended square feet of ice surface per ton of refrigeration for different types of rinks exposed to various conditions, rink construction, brine temperatures required, methods of brine piping and controls. Reference should be made to this information when making calculations.

In general, the tonnage requirement will depend upon a number of variable factors: location and type of rink, solar and conduction heat gains, relative humidity, number of participants and spectators to be accommodated, and various other sources of heat gain. The load may range from one ton per 100 square feet of ice surface to one ton per 500 square feet, with the average being between 250 to 300 square feet per ton.

## Temperature of the Brine

To maintain a reasonably uniform brine temperature throughout the rink piping, the brine is usually circulated at a velocity of from 130 to 150 fpm. Under design conditions the brine's supply and return temperature difference should not exceed 2 deg F. This usually means that the brine pump must circulate approximately 15 gpm of brine per ton of refrigeration required. Brine temperature leaving the chiller or evaporator is usually maintained at from 12 to 19 deg. Experience has shown that this will provide the proper ice temperature in northern climates.

Calcium chloride brine or an ethylene glycol mixture are most commonly used for this work. Of the two, calcium chloride is more popular because of its much lower cost for the initial charge. However, ethylene glycol (with inhibitors) prevents corrosion and scaling which are more prevalent with calcium chloride. To provide freeze-up protection down to minus 25 deg requires 26% calcium chloride in water solution or 45% ethylene glycol in water solution. Concentrations should not be greater than required because they reduce the heat transfer rate, thus making it necessary to use more evaporator surface.

## Refrigeration Equipment

Although a few early installations used direct expansion refrigerant in the rink piping, codes now prohibit the use of ammonia and severely restrict the direct use of more recently developed refrigerants in this secondary piping. In addition, the refrigerant charge in such systems would be excessive, and any leaks could result in a serious financial loss.

For many years the most commonly installed systems combined an ammonia refrigeration plant with a calcium chloride rink freezing and brine storage circuit. With

Fig. 2. Rink supply and return header trench with each 2-pass run equipped with a shut-off valve permits freezing in sections.

the advent of Freon-12 in 1930, designers began working on machines which could operate with approximately one-third the compression ratio required by ammonia systems. This enabled manufacturers to produce compressors which were far lighter, smaller, quieter, more economical and safer to operate than the existing ammonia machines. Following World War II, rapid advances in air conditioning technology brought more efficient multi-capacity compressors designed for use with Freon-12 and other newly developed refrigerants. Many of these new compressors provide continuous automatic operation at various partial loads—a definite advantage during the freezing and holding phases of ice rink operation.

### Packaged Brine Chillers

One of the latest trends in artificial ice rink construction is the use of packaged brine chilling units. An example of this trend is evidenced by American Ice Rinks, Inc. of Cliffside Park, N. J., who installed packaged units this past winter to freeze skating rinks in West New York, N. J. and Freeport, Long Island, N. Y. At each rink they installed two 100-horsepower units (see Fig. 3) each with duplex compressors equipped with automatic cylinder unloaders.

Packaged brine chillers of this type are available in sizes from 10 through 150-horsepower. They may include one or two compressors, a motor, condenser, evaporator, and necessary accessories and controls for automatic operation. They are usually shipped as a complete unit (Fig. 4) and are adaptable to mobile installations.

The components of packaged brine chillers can be selected for specific applications. The compressor usually operates at approximately 5 deg suction temperature.

The condenser is selected for approximately 85 deg condensing in most cases since condenser water is usually available at a temperature of 55 to 65 deg during the fall and winter. The available condenser water should be checked closely, in order that the unit may be properly and economically selected.

The motor is relatively small since the compressor operates at low suction and low condensing temperatures, and thus requires less brake horsepower. It must be large enough, however, to handle the initial pull-down load.

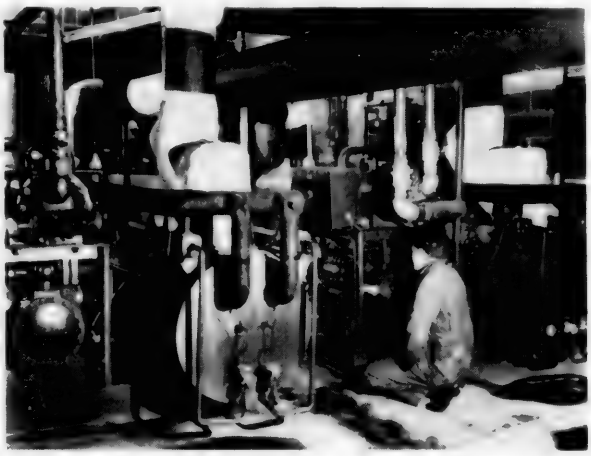

Fig. 3. Two 100-hp Trane Cold Generators provide refrigeration for an outdoor rink in West New York, N. J.

Fig. 4. Space-saving packaged unit provides all the refrigeration required by a four-pad curling rink.

The chiller must be of proper material to handle the brine in the system. Ethylene glycol, if used, can be handled by standard chiller construction with copper tubes. When using calcium chloride, steel tubes must be used. Since the system is normally designed with a high rate of brine flow, the chiller must have wide baffle spacing in order to keep the pressure drop down to a reasonable value. Due to lower heat transfer rates with brine, the chiller is usually larger than would be required for comfort air conditioning with chilled water.

### Controls

Capacity of the unit should be modulated on the basis of brine temperature entering the chiller. The modulating thermostat, designed for low temperature operation, controls loading and unloading of the compressor cylinders to match the load requirements. During freezing, the unit will operate at full capacity. However, during the holding cycle, the compressor will be partially unloaded, operating economically to maintain desired brine temperatures. A low-limit thermostat should be installed in the chiller shell to prevent freeze-up. Its interlock breaks the electrical circuit to the unit when brine temperature falls below a preset safe minimum.

The most frequently used type of control is based upon the same brine temperature for both freezing and holding. However, since holding does not require as low a brine temperature as is required for freezing, another popular method of control involves two brine temperatures. For example: 12 deg brine may be used for freezing, and 19 deg brine for holding. At the higher brine temperature the suction temperature is higher and the compressor is more efficient. Thus since the system is holding most of the time, the dual-temperature system is more economical. Separate temperatures can be provided by using a standard type control panel when freezing, and manually changing over to a second modulating thermostat set at the higher brine temperature for holding. Since personnel are usually present during the freezing cycle, this change-over need not be automatically operated.

It is often desired to use two complete refrigeration machines with sequence control. This control permits selection of either machine as the primary unit, with the

other one being selected to handle the excess load. The compressors can be controlled from a common modulating thermostat, loading and unloading in sequence. One unit will normally carry the holding load, which will mean lower operating expenses.

Brine should always be circulating through the evaporator when the compressor is operating, otherwise uneven temperatures in the evaporator might allow freeze-up to occur even though a low-limit temperature control is provided. This could happen in the event of brine pump motor failure. Therefore the brine pump motor should be started first. When energized, its interlock closes the electrical circuit to energize the compressor motor.

### Accessories

Standard accessories, such as mufflers and vibration isolation bases, are commonly used with packaged brine chillers. Most units are shipped completely assembled on a rigid frame which can be set directly on a level floor. Crankcase heaters are usually recommended since the compressor is normally installed in a cool place. Adequate heat must be provided in the equipment room to prevent freezing of the condenser water during extended periods of low outdoor temperatures.

### Construction Costs

It is difficult to set down any accurate estimates on costs because of the different variables encountered on each specific job. However, the complete installed cost (not including land) of nine permanent indoor rinks built recently in the northern United States and Canada averaged $6.54 per square foot of ice surface. These rinks were all 85 by 185 ft or larger. By comparison, the cost of six outdoor roll-up type rinks of approximately the same size varied from $3.20 per square foot of ice surface to $4.20, with the average falling at approximately $3.90.

According to these figures, the average indoor rink, 85 by 185 ft in size, costs approximately $100,000 while the same size outdoor roll-up type rink runs about $60,000. However, it will cost about $1,000 each time an outdoor roll-up rink of this size is taken up or relaid. In addition, outdoor artificial rinks will lose approximately 45 skating days during their normal five to six month skating season because of unfavorable weather. This reduces their total skating days to approximately 120 each season. The indoor rink which is shaded and protected from the wind and snow enjoys nearly 200 skating days during a normal season, and can be designed for year around operation if desired. From these figures, it is easy to understand why most operators of outdoor artificial rinks start looking for ways to lengthen their season after the first year of operation. Canvas walls, used to protect the ice surface from wind, are very popular. To shade the skating area, large tents are used at a few rinks, while at others, temporary cloth roofs are suspended on tightly stretched wires. However, none of these methods can make outdoor artificial rinks practical in the South.

Because the skating fever is rapidly migrating southward into areas where indoor artificial rinks are the only practical answer, the boom in indoor rink construction in southern states is just beginning. With traveling ice shows continuing to inspire would-be skaters, and with Americans everywhere finding more and more time for recreation, both skating and curling are expected to become popular nationwide pastimes. It is predicted that within five years the total number of artificial ice rinks in the U. S. will be doubled. In addition, it is expected that the refrigeration for at least half of these new rinks will be provided by packaged brine chillers.

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## Dual-Duct System

The most important function of dual-duct systems, according to N. S. Shataloff, New York, N. Y., engineer, is to provide flexible temperature control to a multiplicity of zones and spaces fed by one or more systems.

His paper, Elements of Dual-Duct Design and Performance, presented at the Annual Meeting of ASHAE, offered a method for analyzing dual-duct systems which predicts the resulting state of air under changing operating conditions. This is a distinct advantage because of the large number of variables affecting the performance of a dual-duct system.

Basic cycles were analyzed, and the effect of the operation of the whole system on the performance of the individual zones is described. The elements of system design were also outlined in Mr. Shataloff's paper.

### Branch Fitting Performance at High Velocity

The present trend toward the use of higher velocities in air duct systems emphasizes the need for more accurate design data encompassing a greater range of velocities.

C. M. Ashley, chief staff engineer; S. F. Gilman, head, air conditioning systems and equipment section; and R. A. Church, senior engineer; all of the Carrier Corp. presented in another ASHAE paper an analysis based on laboratory tests of a divided-flow fitting. Pressure losses both in the straight-through section of the constant area main and in the branch takeoff were considered.

### Static Regain

A critical examination of the usual method of correlating static regain test data showed that regain coefficient values above 1.0 are possible. Confirmation was obtained through analytical relationships developed by the authors for particular flow conditions and also by original experimental data. A static regain chart for main ducts and pressure loss curves for conical takeoffs is presented in the paper in a form usable by application engineers.

# Centrifugal Pump Application

## Part 4.—Characteristic Curves and Pump Relations

IGOR J. KARASSIK AND ROY CARTER

Harrison Pump Division, Worthington Corporation, Harrison, N. J.

**This analysis of characteristics including capacity, head, efficiency, and horsepower is fourth in a five-part series.**

A centrifugal pump operating at constant speed, can deliver any capacity from zero to some maximum value which depends upon the design and size of the pump and on the suction conditions. The total head developed by the pump, the power required to drive it and the resulting efficiency, all vary with the capacity. The interrelation of capacity, head, power and efficiency is commonly known as characteristics of the pump.

This interrelation is best shown in graphs which show the pump's characteristic curves. In such graphs it is usual to plot the head, the power input and the efficiency against capacity at a constant speed, as shown in Fig. 14. When variable speed drivers (such as turbines or wound rotor motors) are used, a fifth component, the operating speed expressed in rpm is involved. Where suction conditions may be critical, the limit of suction lift vs. capacity or required net positive suction head (NPSH) vs. capacity is often shown.

The curve H-Q, showing the relation between capacity and total head (see Fig. 14), is called the head-capacity curve.

The curve showing the relation between pump efficiency and capacity, is properly called the efficiency-capacity curve, but is commonly referred to merely as the efficiency curve. The curve P-Q, showing the relation between power-input and pump capacity is the power-capacity curve, but is generally referred to as the power curve or as the brake horse-power (bhp) curve.

Usually the graph of a pump characteristic is made for a capacity range of zero to the maximum operating capacity of the unit. In some cases, the curve is made for a limited range in capacity.

Pump head-capacity curves are often classified by their shapes. Terminology in common use is:

*(a) Rising characteristic* or, more correctly, rising head-capacity characteristic, meaning a curve in which the head rises continuously as the capacity is decreased. (See Fig. 15a.)

*(b) Drooping characteristic* a shortened form of the true name of drooping-head-capacity characteristic, cov-

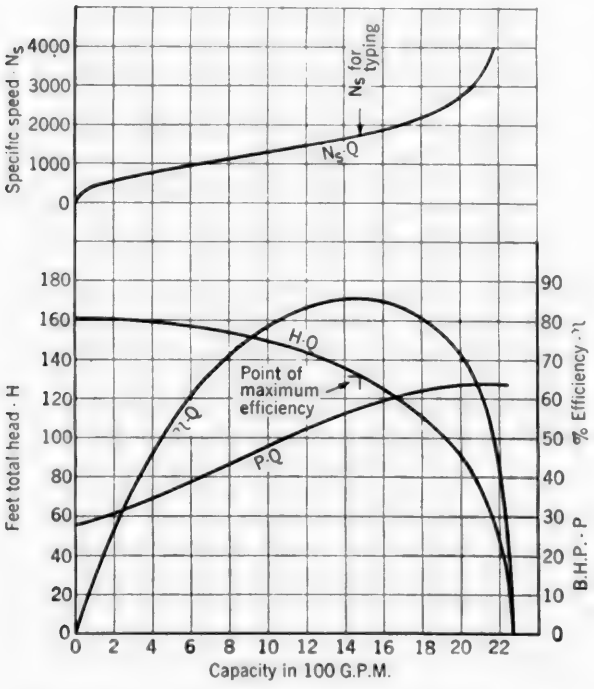



Fig. 14. Characteristic curves of a double suction, single stage volute centrifugal pump with 8-inch suction and 6-inch discharge, at 1760 rpm.

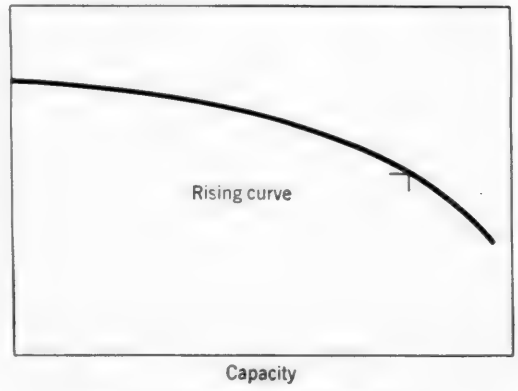



Fig. 15a. Rising head-capacity curve.

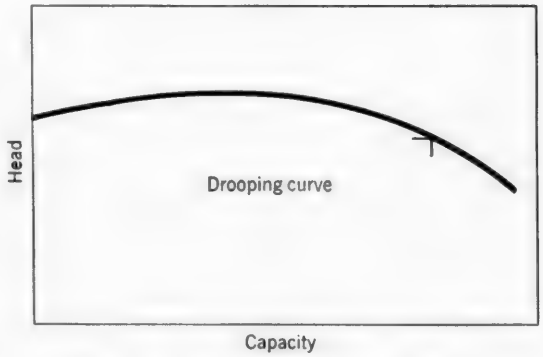



Fig. 15b. Drooping head-capacity curve.

ering cases in which the head-capacity developed at shut-off is less than that developed at some capacities. (This is also known as a looping curve.) (See Fig. 15b.)

*(c) Steep characteristic*, referring to a rising head-capacity characteristic, in which there is a large increase in head between that developed at design capacity and that developed at shut-off. It is sometimes applied to a limited portion of the curve: for example a pump may be said to have a steep characteristic between 50% and 100% of the design capacity. (See Fig. 15c.)

*(d) Flat characteristic*, referring to a head-capacity characteristic in which the head varies slightly with capacity from shut-off to design capacity. The characteristic might be, in addition, either drooping or rising. All drooping curves have a portion in which the head developed is approximately constant for a certain range in capacity. In such cases that range is called the flat portion of the curve. The qualification of flat is also applied at times to indicate the general shape of other curves either for their full range or for a limited range. (See Fig. 15d.)

*(e) Stable characteristic*, referring to a head-capacity characteristic in which only one capacity can be obtained at any one head. Basically this has to be a rising characteristic. (See Figs. 15a, c, d.)

*(f) Unstable characteristic*, referring to a head-capacity characteristic in which the same head is developed at two or more capacities. The successful application of any pump is dependent as much upon the characteristic of the system on which it is operated as upon the head-capacity characteristic. Most pumping systems permit the use of pumps with moderately unstable characteristics.

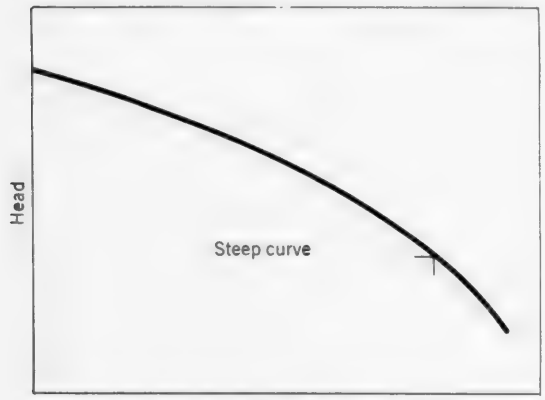


Fig. 15c. Steep head-capacity curve.

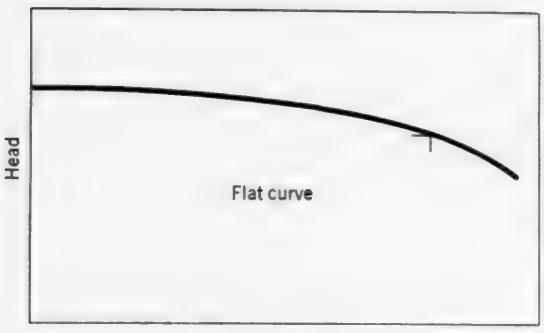


Fig. 15d. Flat head-capacity curve.

In addition to the names applied to the shape of the head-capacity (H-Q) curves, the power-capacity (P-Q) curves have also been classified according to their shapes. Fig. 16 illustrates a pump characteristic with a power (P-Q) curve (bhp on graph) which flattens out and then decreases as the capacity increases beyond the maximum efficiency point. This is called a non-overloading curve. When the power (P-Q) curve continues to increase with an increase in capacity, as in the characteristic shown in Fig. 17 as the (bhp) curve, the pump is said to have an overloading curve. The shape of the power curves (P-Q or bhp) varies with the specific speed type. As a result the power curve may be one which has a very low value at shut-off, as illustrated in Figs. 16 and 17, or it may be one which has a high shut-off power as illustrated in Fig. 18 or anything between these types. While in Fig. 17 the (P-Q) or (bhp) curve is of the overloading type with a *decrease in head and increase in capacity*, the (P-Q) or (bhp) curve shown in Fig. 16 is of the overloading type with an *increase in head and decrease in capacity*.

While pumps with non-overloading power curves are advantageous because the driver is not overloaded under any operating conditions, they are not obtainable in all specific speed types of pumps. The actual range in operating conditions to be encountered in the operation of a pump determines the range in power requirements and the driver size should be selected for the power demand to be encountered.

## Mathematical Relations

The useful work done by a pump is naturally the weight of liquid pumped in a period of time multiplied by the head developed by the pump. This is generally expressed in terms of horsepower and is called Water Horsepower (whp). It can be determined by the relation,

$$WHP = Q \times H \cdot \frac{\text{specific gravity}}{3960}$$

where

Q = pump capacity in gpm.
H = total head in feet.

The power required to drive the pump is regularly determined in horsepower and is called the (bhp) input to

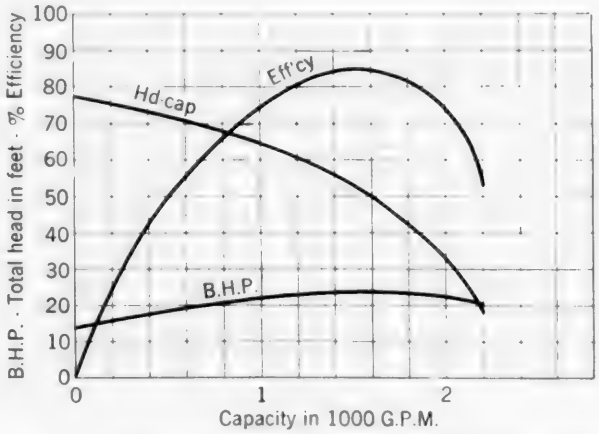


Fig. 16. Characteristics of a pump with non-overloading power curve with decrease in head.

the pump. The ratio of the (whp) output to the (bhp) input is the pump efficiency. The relation between (bhp), capacity, head and efficiency is therefore

$$BHP = \frac{Q \times H}{\text{efficiency}} \times \frac{\text{specific gravity}}{3960}$$

## Centrifugal Pump Relations

There are certain relations whereby the performance of a centrifugal pump can be predicted for another speed than that at which the pump characteristic is known. There are also certain relations whereby we can predict the performance of a pump if the impeller were to be cut down in diameter (within a limit depending upon the impeller design) from the characteristics obtained at the larger diameter.

When the speed is changed:

(1) the capacity for a given point on the pump characteristics varies as the speed, while at the same time
(2) the head varies as the square of the speed, and
(3) the brake horsepower varies as the cube of the speed.

Putting these relations in the form of equations, we have

$$Q = Q_1(n/n_1)$$
$$H = H_1(n/n_1)^2$$
$$P = P_1(n/n_1)^3$$

or

$$\frac{n}{n_1} = \frac{Q}{Q_1} = \sqrt{\frac{H}{H_1}} = \sqrt[3]{\frac{P}{P_1}}$$

where—

$n$ = new speed desired in rpm
$Q$ = capacity in gpm at desired speed $n$
$H$ = head in ft. at desired speed $n$ for capacity $Q$
$P$ = brake horsepower at desired speed $n$ at $H$ and $Q$
$n_1$ = speed in rpm at which the characteristics are known
$Q_1$ = a capacity at speed $n_1$
$H_1$ = head at capacity $Q_1$ at speed $n_1$
$P_1$ = brake horsepower at speed $n_1$ at $H_1$ and $Q_1$

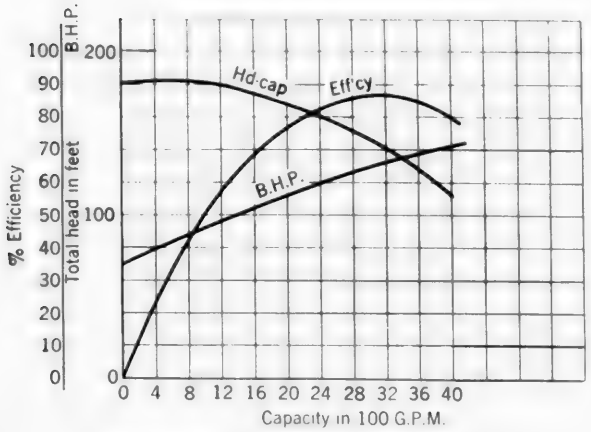



Fig. 17. Characteristics of a pump with overloading power curve with decrease in head.

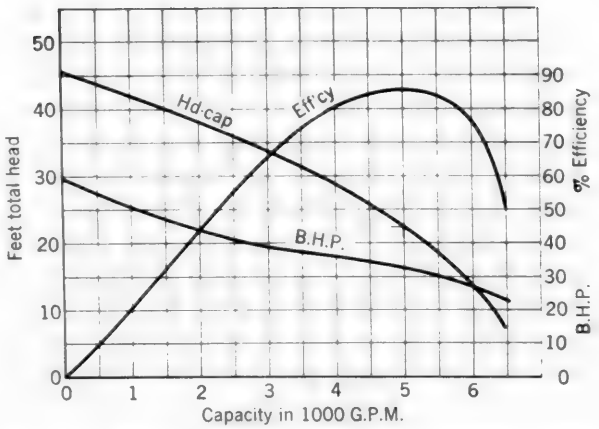



Fig. 18. Characteristics of a pump with overloading power curve with increase in head.

On Fig. 19 there is plotted the 1800 rpm characteristics of a pump which indicates that at that speed it produced 2600 gpm at 210.2 feet total head, taking 162.5 bhp and having 84.9% efficiency. If we desire to obtain the 1600 rpm characteristics, we would correct a number of 1800 rpm points to 1600 rpm. The 2600 gpm point mentioned would be corrected to 1600 rpm as follows:

$$H = 2600 \times (1600/1800) = 2311 \text{ gpm}$$
$$Q = 210.2 \times (1600/1800)^2 = 166.1 \text{ ft}$$
$$P = 162.5 \times (1600/1800)^3 = 114.1 \text{ bhp}$$

The resulting 1600 rpm characteristics are also shown in Fig. 19.

These relations for change in speed can be used with safety for moderate changes in speed. They may not be found accurate in case of a large change in speed, particularly in case of an increase in speed.

It is also possible to reduce the diameter of the impeller by actually cutting it down in a lathe. The average impeller can be cut down in diameter about 20% of its original maximum diameter without adverse effect. Cutting it down to less than 80% of its original diameter will generally result in a much lower efficiency. This limit of 20% is of course merely approximate as some designs of impellers can be cut more than this, while others cannot be cut more than a small percentage without adverse effect. Actually any change in diameter will affect the proportions of the impeller and some variations from the theoretical results should be expected when tested. It is found if an impeller of a suitable design is cut in diameter that, at the same speed, the characteristic of the pump will have a definite relation to its original characteristics or closely so. These relations are:

(1) the capacity for a given point in the pump characteristic varies as the impeller diameter, while at the same time—
(2) the head varies as the square of the impeller diameter, and
(3) the horsepower varies as the cube of the impeller diameter.

Expressed in form of equations, these are:

$$Q = Q_1(D/D_1)$$
$$H = H_1(D/D_1)^2$$
$$P = P_1(D/D_1)^3$$

$$\frac{D}{D_1} = \frac{Q}{Q_1} = \sqrt{\frac{H_1}{H}} = \sqrt[3]{\frac{P}{P_1}}$$

where

$D_1$ = original diameter, inches
$D$ = cut down diameter, inches
$Q_1$ = capacity with $D_1$ impeller
$Q$ = corresponding capacity with $D$ impeller
$H_1$ = head with $D_1$ impeller at capacity $Q_1$
$H$ = corresponding head with $D$ impeller at capacity $Q$
$P_1$ = BHP with $D_1$ impeller at capacity $Q_1$ and Head $H_1$

$P$ = bhp with D impeller at capacity $Q$ and head $H$

Considering again the same pump which at one point at 1800 rpm gave 2600 gpm 210.2 ft thd 162.5 bhp, 84.9% efficiency and which had an impeller diameter of 14¾ inches and assuming the impeller was cut to 14 inches diameter, the corresponding point on the characteristics of the pump with a 14-inch diameter impeller at 1800 rpm would be determined as follows:

$$Q = 2600 \times (14/14.75) = 2468 \text{ gpm}$$
$$H = 210.2 \times (14/14.75)^2 = 189.4 \text{ ft}$$
$$P = 162.5 \times (14/14.75)^3 = 139 \text{ bhp}$$

Doing this likewise with a number of other points, sufficient points on the 1800 rpm characteristics of the 14-inch diameter impeller could be obtained to permit drawing the curves making up Fig. 20.

### Example

The most common problems utilizing these relations are to determine the change in speed, the change in diameter of the impeller, or a combination of both necessary to produce a head-capacity characteristic passing through a given point. For example, suppose we have to meet the condition of 3000 gpm, 180 ft thd. Since this falls below the head-capacity (H-Q) curve of the 14¾-inch impeller at 1800 rpm shown on Fig. 19 we can obtain the desired (H-Q) by reducing the speed or reducing the diameter of the impeller.

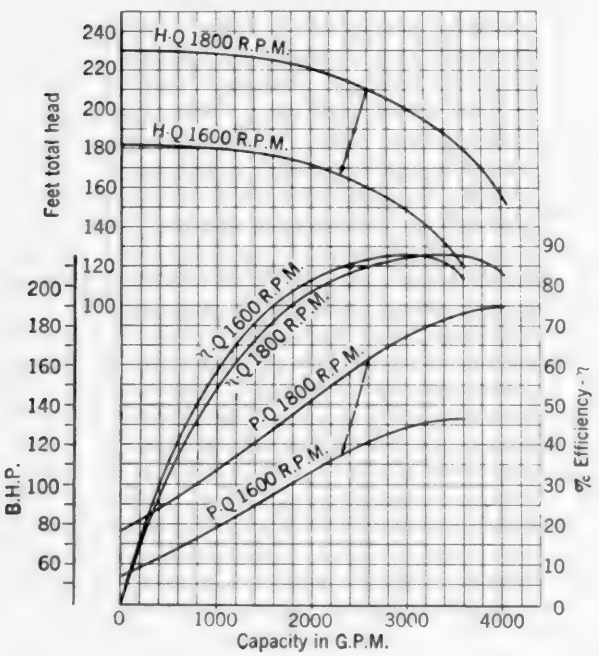



Fig. 19. Effect of speed change on pump characteristics.

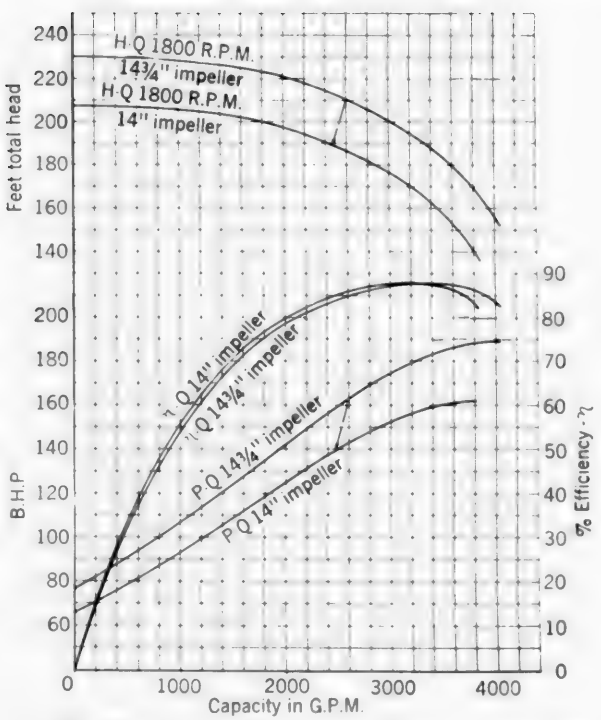



Fig. 20. Effect of impeller diameter change on centrifugal pump characteristics.

If the desired pump which is to give 3000 gpm 180 ft was speeded up or the impeller diameter increased so that point on the characteristic became 3100 gpm, the head, at the same time, would have become $180 \times (3100/3000)^2$ or 192.2 ft. Similarly if 3200 gpm was obtained by a further increase in speed or impeller diameter the head would be $180 \times (3200/3000)^2$ or 204.8 ft. Plotted as shown in Fig. 19 these form a section of a curve (A). This intersects the 1800 rpm (14¾ inches $D_2$), H-Q characteristic at 3135 gpm 196.5 ft indicating the point on that characteristic from which we have to work. Now if we are to obtain 3000 gpm at 180 ft thd, we can determine the required speed by the calculation $1800 \times (3000/3135)$ or by $1800 \times (180/196.5)^{1-2}$ both of which give 1723 rpm. Should it have been that no speed change was desired, it would have required a diameter change of $14.75 \times (3000/3135)$ or 14.12 inches. Had the new driver run at 1760 rpm, the 14¾-inch diameter impeller would have given 3065 gpm 187.9 ft thd requiring in addition a cut in the impeller diameter to 14.44 inches. In all three cases a new curve which would pass through 3000 gpm and 180 ft thd can be plotted by stepping down a number of the 1800 rpm 14¾-inch diameter curve points, the capacities being reduced by the ratio of (3000/3135) with the corresponding heads being reduced by the ratio of $(3000/3135)^2$ and the corresponding bhp being reduced by the ratio of $(3000/3135)^3$ or the bhp can be calculated from the resulting capacity and head and the pump efficiency at the point in question.

# WEIGHT OF FREON-12 IN TYPE K LINES IN OPERATION

## SUCTION LINE

| Nominal Dia., In. | Outside Dia., In. | Suction Temperature, Deg. F | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 | 40 | 30 | 20 | 10 | 0 | −10 | −20 | −30 |
| | | Weight of Freon-12 per Foot of Type K Tube, Lb. | | | | | | | | |
| 3/8 | 1/2 | .0013 | .0011 | .0009 | .0008 | .0007 | .0005 | .0004 | .0004 | .0003 |
| 1/2 | 5/8 | .0022 | .0019 | .0016 | .0013 | .0011 | .0009 | .0008 | .0006 | .0005 |
| 5/8 | 3/4 | .0034 | .0029 | .0025 | .0021 | .0017 | .0014 | .0012 | .0009 | .0008 |
| 3/4 | 7/8 | .0045 | .0038 | .0032 | .0027 | .0022 | .0019 | .0015 | .0012 | .0010 |
| 1 | 1 1/8 | .0080 | .0068 | .0058 | .0048 | .0040 | .0033 | .0027 | .0022 | .0017 |
| 1 1/4 | 1 3/8 | .0125 | .0106 | .0090 | .0075 | .0063 | .0052 | .0042 | .0034 | .0027 |
| 1 1/2 | 1 5/8 | .0178 | .0151 | .0127 | .0107 | .0089 | .0073 | .0060 | .0048 | .0039 |
| 2 | 2 1/8 | .0311 | .0264 | .0223 | .0187 | .0155 | .0128 | .0104 | .0085 | .0068 |
| 2 1/2 | 2 5/8 | .0480 | .0408 | .0344 | .0288 | .0239 | .0197 | .0161 | .0131 | .0105 |
| 3 | 3 1/8 | .0684 | .0582 | .0491 | .0411 | .0341 | .0281 | .0230 | .0186 | .0149 |
| 3 1/2 | 3 5/8 | .0928 | .0789 | .0666 | .0557 | .0463 | .0382 | .0312 | .0253 | .0202 |
| 4 | 4 1/8 | .1205 | .1025 | .0864 | .0724 | .0600 | .0496 | .0405 | .0328 | .0263 |
| 5 | 5 1/8 | .1869 | .1590 | .1341 | .1123 | .0932 | .0769 | .0628 | .0509 | .0408 |
| 6 | 6 1/8 | .2668 | .2269 | .1913 | .1603 | .1330 | .1098 | .0897 | .0726 | .0582 |

## HOT GAS LINE

| Nominal Dia., In. | Outside Dia., In. | Condensing Temperature, Deg. F | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 |
| | | Weight of Freon-12 per Foot of Type K Tube, Lb. | | | | | | | | |
| 3/8 | 1/2 | .0021 | .0022 | .0024 | .0026 | .0028 | .0030 | .0032 | .0034 | .0037 |
| 1/2 | 5/8 | .0036 | .0038 | .0041 | .0044 | .0047 | .0051 | .0055 | .0059 | .0063 |
| 5/8 | 3/4 | .0055 | .0059 | .0063 | .0068 | .0073 | .0078 | .0084 | .0090 | .0097 |
| 3/4 | 7/8 | .0071 | .0077 | .0082 | .0089 | .0095 | .0102 | .0109 | .0118 | .0126 |
| 1 | 1 1/8 | .0127 | .0137 | .0147 | .0158 | .0169 | .0182 | .0195 | .0210 | .0225 |
| 1 1/4 | 1 3/8 | .0199 | .0214 | .0230 | .0247 | .0265 | .0285 | .0305 | .0329 | .0352 |
| 1 1/2 | 1 5/8 | .0281 | .0303 | .0325 | .0350 | .0375 | .0403 | .0432 | .0465 | .0498 |
| 2 | 2 1/8 | .0492 | .0531 | .0569 | .0613 | .0656 | .0706 | .0755 | .0814 | .0872 |
| 2 1/2 | 2 5/8 | .0760 | .0820 | .0879 | .0946 | .1013 | .1090 | .1167 | .1257 | .1347 |
| 3 | 3 1/8 | .1084 | .1169 | .1254 | .1349 | .1444 | .1554 | .1663 | .1792 | .1920 |
| 3 1/2 | 3 5/8 | .1470 | .1585 | .1700 | .1830 | .1959 | .2108 | .2256 | .2430 | .2604 |
| 4 | 4 1/8 | .1909 | .2058 | .2207 | .2375 | .2543 | .2736 | .2928 | .3155 | .3380 |
| 5 | 5 1/8 | .2962 | .3193 | .3425 | .3685 | .3946 | .4246 | .4544 | .4895 | .5245 |
| 6 | 6 1/8 | .4228 | .4558 | .4889 | .5261 | .5633 | .6060 | .6486 | .6987 | .7487 |

## LIQUID LINE

| Nominal Dia., In. | Outside Dia., In. | Liquid Temperature, Deg. F | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| | | Weight of Freon-12 per Foot of Type K Tube, Lb. | | | | | | | | |
| 3/8 | 1/2 | .0758 | .0747 | .0737 | .0727 | .0716 | .0705 | .0693 | .0682 | .0669 |
| 1/2 | 5/8 | .1300 | .1283 | .1265 | .1247 | .1229 | .1210 | .1190 | .1170 | .1148 |
| 5/8 | 3/4 | .1998 | .1971 | .1944 | .1916 | .1888 | .1859 | .1828 | .1797 | .1764 |
| 3/4 | 7/8 | .2609 | .2574 | .2539 | .2503 | .2466 | .2427 | .2388 | .2347 | .2303 |
| 1 | 1 1/8 | .4649 | .4587 | .4524 | .4460 | .4395 | .4326 | .4255 | .4183 | .4105 |
| 1 1/4 | 1 3/8 | .7275 | .7177 | .7079 | .6980 | .6877 | .6769 | .6659 | .6545 | .6424 |
| 1 1/2 | 1 5/8 | 1.0298 | 1.0159 | 1.0020 | .9879 | .9734 | .9581 | .9424 | .9264 | .9092 |
| 2 | 2 1/8 | 1.8012 | 1.7769 | 1.7527 | 1.7280 | 1.7027 | 1.6759 | 1.6485 | 1.6205 | 1.5903 |
| 2 1/2 | 2 5/8 | 2.7828 | 2.7453 | 2.7078 | 2.6696 | 2.6305 | 2.5892 | 2.5468 | 2.5035 | 2.4570 |
| 3 | 3 1/8 | 3.9666 | 3.9132 | 3.8597 | 3.8054 | 3.7496 | 3.6907 | 3.6303 | 3.5686 | 3.5022 |
| 3 1/2 | 3 5/8 | 5.3804 | 5.3079 | 5.2354 | 5.1617 | 5.0861 | 5.0061 | 4.9242 | 4.8405 | 4.7505 |
| 4 | 4 1/8 | 6.9844 | 6.8903 | 6.7962 | 6.7005 | 6.6024 | 6.4985 | 6.3923 | 6.2836 | 6.1667 |

Nominal diameters are 1/8 inch less than actual outside diameters.

# WEIGHT OF FREON-12 IN TYPE L LINES IN OPERATION

## SUCTION LINE

| Nominal Dia., In. | Outside Dia., In. | Suction Temperature, Deg. F | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 | 40 | 30 | 20 | 10 | 0 | −10 | −20 | −30 |
| | | Weight of Freon-12 per Foot of Type L Tube, Lb. | | | | | | | | |
| 3/8 | 1/2 | .0015 | .0013 | .0011 | .0009 | .0008 | .0006 | .0005 | .0004 | .0003 |
| 1/2 | 5/8 | .0024 | .0020 | .0017 | .0014 | .0012 | .0010 | .0008 | .0006 | 0005 |
| 5/8 | 3/4 | .0036 | .0031 | .0026 | .0022 | .0018 | .0015 | .0012 | .0010 | .0008 |
| 3/4 | 7/8 | .0050 | .0042 | .0036 | .0030 | .0025 | .0021 | .0017 | .0014 | .0011 |
| 1 | 1 1/8 | .0085 | .0072 | .0061 | .0051 | .0042 | .0040 | .0029 | .0023 | .0019 |
| 1 1/4 | 1 3/8 | .0130 | .0110 | .0093 | .0078 | .0065 | .0053 | .0044 | .0035 | .0028 |
| 1 1/2 | 1 5/8 | .0183 | .0156 | .0131 | .0110 | .0091 | .0075 | .0067 | .0050 | 0040 |
| 2 | 2 1/8 | .0319 | .0271 | .0229 | .0192 | .0159 | .0131 | .0107 | .0087 | .0070 |
| 2 1/2 | 2 5/8 | .0492 | .0418 | .0353 | .0295 | .0245 | .0202 | .0165 | .0134 | .0107 |
| 3 | 3 1/8 | .0702 | .0597 | .0503 | .0422 | .0350 | .0289 | .0236 | .0191 | .0153 |
| 3 1/2 | 3 5/8 | .0950 | .0808 | .0681 | .0571 | .0474 | .0391 | .0319 | .0259 | .0207 |
| 4 | 4 1/8 | .1234 | .1050 | .0885 | .0742 | .0615 | .0508 | .0415 | .0336 | .0269 |
| 5 | 5 1/8 | .1924 | .1636 | .1380 | .1156 | .0959 | .0792 | .0647 | 0524 | .0420 |
| 6 | 6 1/8 | .2765 | .2352 | .1983 | .1661 | .1378 | .1138 | .0930 | .0753 | .0603 |

## HOT GAS LINE

| Nominal Dia., In. | Outside Dia., In. | Condensing Temperature, Deg. F | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 |
| | | Weight of Freon-12 per Foot of Type L Tube, Lb. | | | | | | | | |
| 3/8 | 1/2 | .0024 | .0026 | .0027 | .0030 | .0032 | .0034 | .0036 | .0039 | .0042 |
| 1/2 | 5/8 | .0038 | .0041 | .0044 | .0047 | .0050 | .0054 | .0058 | .0062 | .0067 |
| 5/8 | 3/4 | .0057 | .0061 | .0066 | .0071 | .0076 | .0081 | .0087 | .0094 | .0101 |
| 3/4 | 7/8 | .0079 | .0085 | .0091 | .0098 | .0105 | .0113 | .0121 | .0130 | .0140 |
| 1 | 1 1/8 | .0135 | .0145 | .0156 | .0167 | .0180 | .0193 | .0207 | .0222 | .0239 |
| 1 1/4 | 1 3/8 | .0205 | .0221 | .0237 | .0255 | .0273 | .0293 | .0315 | .0338 | .0363 |
| 1 1/2 | 1 5/8 | .0291 | .0313 | .0336 | .0361 | .0387 | .0415 | .0446 | .0479 | .0515 |
| 2 | 2 1/8 | .0505 | .0544 | .0584 | .0628 | .0673 | .0722 | .0775 | .0833 | .0895 |
| 2 1/2 | 2 5/8 | .0779 | .0839 | .0901 | .0968 | .1038 | .1114 | .1196 | .1284 | .1380 |
| 3 | 3 1/8 | .1112 | .1197 | .1286 | .1382 | .1482 | .1590 | .1707 | .1834 | .1970 |
| 3 1/2 | 3 5/8 | .1505 | .1620 | .1741 | .1869 | .2006 | .2152 | .2310 | .2481 | .2666 |
| 4 | 4 1/8 | .1956 | .2105 | .2262 | .2429 | .2606 | .2796 | .3001 | .3224 | .3464 |
| 5 | 5 1/8 | .3049 | .3281 | .3526 | .3786 | .4062 | .4357 | .4677 | .5025 | .5399 |
| 6 | 6 1/8 | .4382 | .4715 | .5067 | .5441 | .5838 | .6263 | .6723 | .7222 | .7760 |

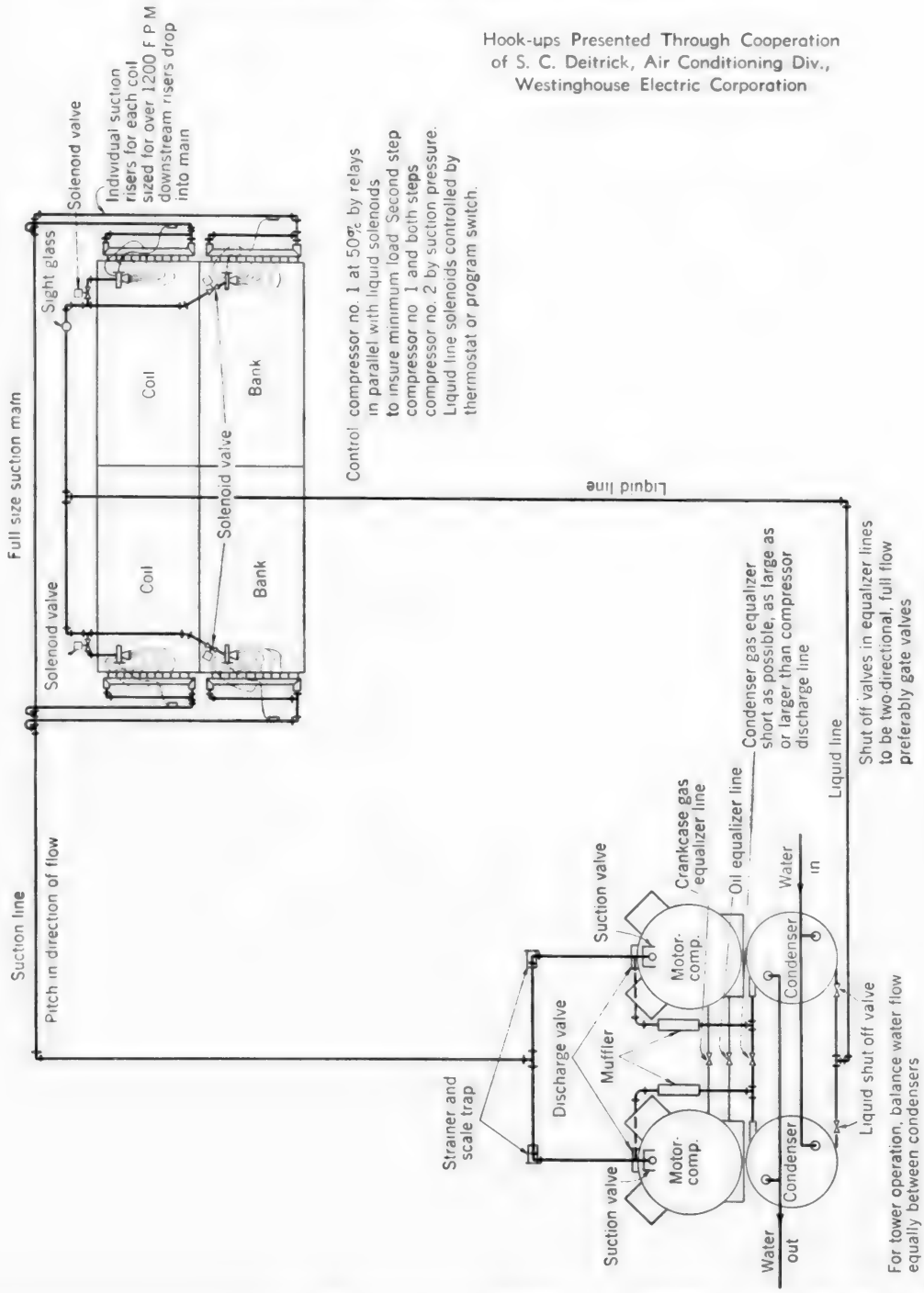
## LIQUID LINE

| Nominal Dia., In. | Outside Dia., In. | Liquid Temperature, Deg. F | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| | | Weight of Freon-12 per Foot of Type L Tube, Lb. | | | | | | | | |
| 3/8 | 1/2 | .0867 | .0858 | .0846 | .0834 | .0822 | .0809 | .0795 | .0782 | .0768 |
| 1/2 | 5/8 | .1386 | .1368 | .1349 | .1330 | .1310 | .1290 | .1269 | .1247 | .1224 |
| 5/8 | 3/4 | .2083 | .2056 | .2027 | .1999 | .1970 | .1939 | .1907 | .1875 | .1840 |
| 3/4 | 7/8 | .2893 | .2854 | .2815 | .2775 | .2735 | .2692 | .2648 | .2603 | .2554 |
| 1 | 1 1/8 | .4934 | .4867 | .4801 | .4733 | .4664 | .4590 | .4515 | .4438 | .4356 |
| 1 1/4 | 1 3/8 | .7508 | .7407 | .7306 | .7203 | .7097 | .6986 | .6871 | .6755 | .6629 |
| 1 1/2 | 1 5/8 | 1.0633 | 1.0490 | 1.0347 | 1.0201 | 1.0052 | .9894 | .9732 | .9566 | .9388 |
| 2 | 2 1/8 | 1.8494 | 1.8245 | 1.7996 | 1.7742 | 1.7483 | 1.7208 | 1.6926 | 1.6638 | 1.6329 |
| 2 1/2 | 2 5/8 | 2.8594 | 2.8209 | 2.7823 | 2.7431 | 2.7030 | 2.6605 | 2.6169 | 2.5724 | 2.5246 |
| 3 | 3 1/8 | 4.0708 | 4.0160 | 3.9611 | 3.9053 | 3.8481 | 3.7876 | 3.7257 | 3.6623 | 3.5942 |
| 3 1/2 | 3 5/8 | 5.5087 | 5.4345 | 5.3602 | 5.2847 | 5.2073 | 5.1254 | 5.0416 | 4.9559 | 4.8638 |
| 4 | 4 1/8 | 7.1575 | 7.0611 | 6.9646 | 6.8665 | 6.7660 | 6.6595 | 6.5506 | 6.4392 | 6.3195 |

# DUAL COMPRESSOR HOOK-UP

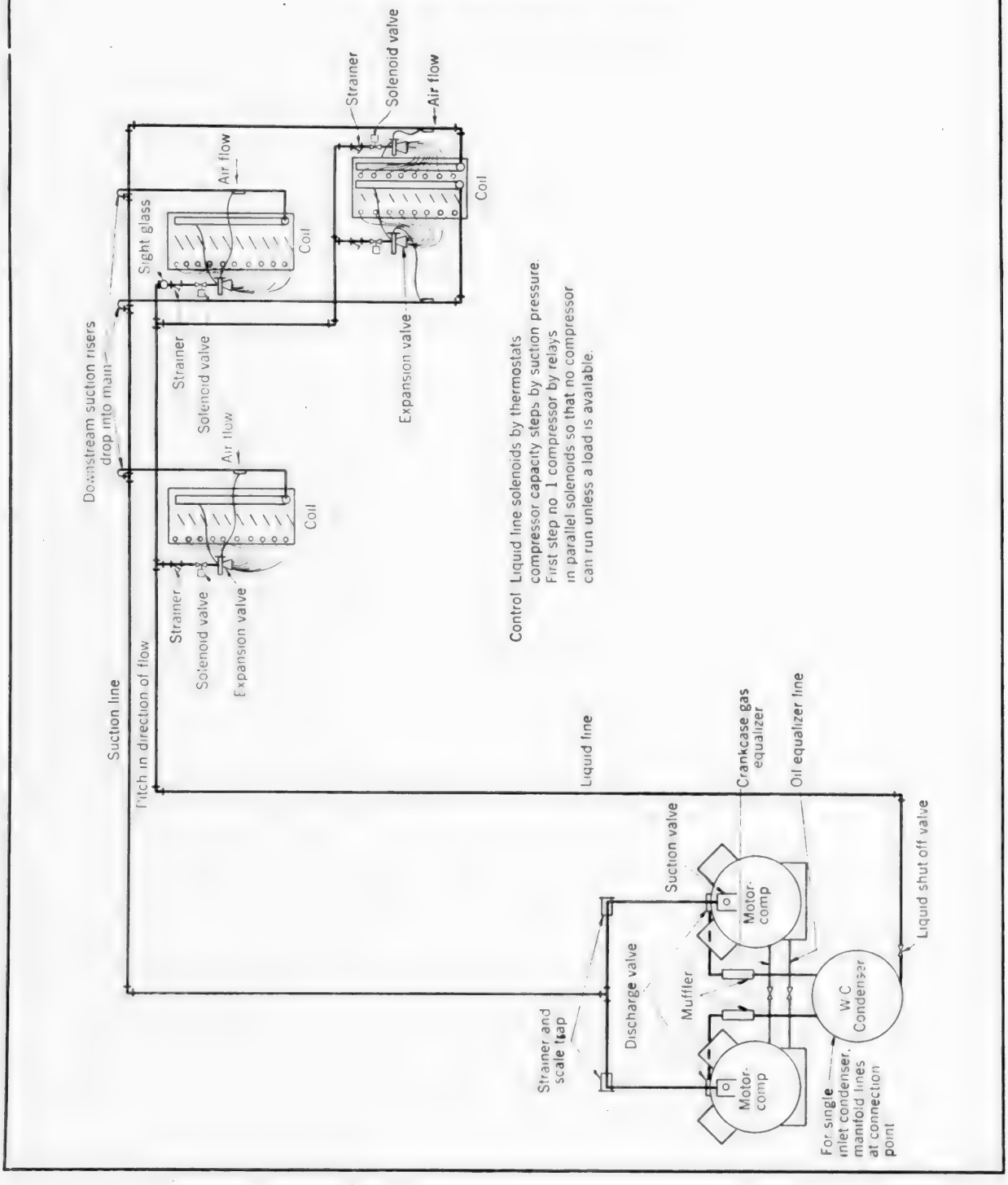
**Two Refrigerating Compressors and Two Water-cooled Condensers Paralleled on Bank of Coils for Zone or Program Control**

Hook-ups Presented Through Cooperation of S. C. Deitrick, Air Conditioning Div., Westinghouse Electric Corporation


Individual suction risers for each coil sized for over 1200 F P M downstream risers drop into main
Solenoid valve
Sight glass
Coil
Bank
Coil
Bank
Solenoid valve
Solenoid valve
Full size suction main
Control compressor no. 1 at 50°F by relays in parallel with liquid solenoids to insure minimum load. Second step compressor no. 1 and both steps compressor no. 2 by suction pressure. Liquid line solenoids controlled by thermostat or program switch.
Liquid line
Condenser gas equalizer short as possible, as large as or larger than compressor discharge line
Liquid line
Shut off valves in equalizer lines to be two-directional, full flow preferably gate valves
Crankcase gas equalizer line
Oil equalizer line
Water in
Suction valve
Motor-comp.
Condenser
Suction line
Pitch in direction of flow
Discharge valve
Muffler
Strainer and scale trap
Liquid shut off valve
Suction valve
Motor-comp.
Condenser
Water out
For tower operation, balance water flow equally between condensers

# DUAL COMPRESSOR HOOK-UP

**Two Refrigerating Compressors and Single Water-Cooled Condenser in Parallel with Multiple Air Units**



**Below and on the following pages are given brief digests of the advertisements appearing in this month's issue. Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail the prepaid postcard to request further information from manufacturers.**

**The items appear in the same order as the advertisements to which they refer, to facilitate obtaining further information after reading an advertisement.**

**NOTE: All advertisements are digested here except those received too late for inclusion. The Index of Advertisers lists all the advertisements in this issue.**

**Use the postcard below for catalogs, new equipment and materials, as well as Ad-Digest items.**

**PIPE HANGERS AND SUPPORTS.** Inside front cover. A complete line of pipe hangers and supports is supplied through a coast-to-coast system of strategically located warehouses and jobbers by this manufacturer. The company maintains a staff of trained personnel, ready to work with customers on the job. ----- **Item 103**

**CORROSIVE FUME EXHAUSTERS.** Page 1. A divided housing fan is manufactured by this company for removing corrosive, high temperature, and hazardous fumes from kilns, chemical plants and laboratories, ovens, tanks, foundries, furnaces, and other installations. Catalog with data on fume removal is available. ---- **Item 104**

**INTEGRAL-FURNACE BOILERS.** Page 4. Three of this company's integral-furnace boilers supply steam through a six-mile main to a coordinated system of air conditioning, heating, and ventilating in a new medical center. Available in standard sizes to 40,000 lb per hr of steam and pressures to 235 psi, the boiler is also in service with moderate superheat for higher operating pressures. Details are available. ---------- **Item 105**

**SNOW MELTING SYSTEM.** Page 9. One snow melting system dates back to 1947 when a network of wrought iron pipe grids, 12 ft wide and 51 ft long, was installed under the sidewalk of an LP-gas service building. A high velocity pump circulates a hot water and antifreeze solution through the wrought iron pipe system. A bulletin on snow melting systems is available. ---------- **Item 106**

**FLUSH VALVES.** Page 11. Diaphragm type flush valves made by this company were selected for New York's Coliseum. A handbook with 19 pages on installation details for exposed, concealed, and special flush valve installations and charts, formulae, and piping details is available. --- **Item 107**

**HEAT EXCHANGERS.** Page 13. Extended-service heat exchangers are made by this manufacturer exclusively. The company has concentrated on one thing and one thing only. Its design, research, engineering, and production experience and facilities are devoted to the manufacture of the heat exchangers. Information is available. ---------- **Item 108**

**AIR FILTERS.** Page 14-15. One man spent less than eight hours a week maintaining this company's air filters on nine air conditioning systems using 200,000 cfm because the units clean themselves continually while cleaning the air. A 12-page booklet with data on the air filter performance is available. ---------- **Item 109**

**SNOW MELTING PIPE.** Page 16. A giant snow melting system for a ferry building has approximately 14 tons of 1-in. steel pipe used in the grids and about 5 tons of sizes up to 3 in. employed as headers and connecting pipes. The characteristics of the pipe — uniform bending and strong welding properties — make it ideal for this application. Descriptive literature is available. ---------- **Item 110**

**GAS UNIT HEATERS.** Between 16-17. A gas-fired heater with a soft green finish and polished chrome medallion, grilles and panel is offered by this company in eight sizes ranging from 25,000 to 310,000 Btu per hr for natural, manufactured, mixed, LP, and LP-air gases. Bulletin is available. ---------- **Item 111**

**Circle numbers corresponding to the items and advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.**

**CENTRIFUGAL PUMPS.** Page 17. Centrifugal pumps are offered by this company for cooling tower applications with capacities to 150 gpm and heads to 115 ft. Both pump and motor are equipped with bronze sleeve bearings and a noise dampening flexible spring-type coupler. Manual on cooling tower systems is available. ---------- **Item 112**

**AIR DISTRIBUTION DATA.** Pages 19 to 21. Practical data on air distribution has been prepared by this manufacturer of air distribution equipment and accessories as a service to those responsible for specifying air distribution equipment. This is the first in a series of technical articles. Assistance for specific problems is offered. ---------- **Item 113**

**AIR CONDITIONING CONTROL.** Page 22-23. This company's equipment controls a complete heat pump system combined with radiant panel heating and cooling as well as central fan air conditioning in a New Mexico building. Panel mounted instruments permit remote observation of air and water temperatures at key points in the system. A company engineer will give recommendations without obligation. ---------- **Item 114**

**CONTROL SYSTEMS.** Page 24-25. The production of precision products in one manufacturer's plant is aided by this company's control system. The control system prevents over-heating and stops fuel waste. Assistance is offered on space heating or process control. ---------- **Item 115**

**ROOF EXHAUSTER.** Page 26. A roof exhauster is made by this manufacturer with U-spring cushion, suspension mounting that eliminates the transmission of vibration and motor hum to the base of the unit. Each unit is individually checked under simulated operating conditions in a sound control room. Information is available. ---------- **Item 116**

**TEMPERATURE CONTROL.** Page 27. The temperature controls offered by this company include a smartly designed thermostat with eye-level reading for standard two-wire low voltage and a device that provides timed cycling of heating systems. The thermostat controls room temperature within a fraction of a degree. Descriptive folder is available. ---------- **Item 117**

**AIR CONDITIONING EQUIPMENT.** Page 28. This company's equipment for fan-coil systems in new and existing multi-room buildings includes: Water cooling machines, hermetic condensing units, cabinet type fan-coil units, and fan-coil units for overhead installation. The fan-coil units are made for direct expansion or water-fed systems in ½ to 1-ton sizes. Information and literature are available. **Item 118**

**DUCT INSULATION.** Page 29. The combination heating-cooling ducts of an 11-story city office building are insulated with this company's long glass fiber insulation. Its thermal efficiency will hold heat loss or gain to a minimum and will dampen vibration. A brochure on the insulation and liner is available. ---------- **Item 119**



**INQUIRY CARD**

**Circle below item numbers on which you wish catalogs or further information.**

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**PLEASE PRINT** May H-56

This service available only to U. S. and Canadian readers.

**Name** ..... **Title** .....

**Firm** .....

**Nature of Firm's Business** .....

**Street** .....

**City** ..... **Zone** ..... **State** .....

This card is void after Aug. 1, 1956

# Ad-Digest

**YEAR-ROUND ROOM UNITS.** Page 30. Year-round air conditioning of commercial and institutional buildings is offered by this company. The company makes a year-round air conditioner for self-contained cooling with central steam or water heating and fan coil units for central cooling and hot water heating systems. Specifications and installation data for the units are available. ---------- **Item 120**

**GALVANIZED SHEET.** Page 31. The coating of this companys galvanized sheet steel will take a Pittsburgh lock without cracking, peeling, or flaking. The coating will take anything the base metal will. Information is available. ---------- **Item 121**

**DRAFT CONTROLS.** Page 32. Draft controls for coal and oil-fired heating plants are heavy-duty, commercial models in 28- and 32-in. sizes. They are also available in 6- to 24-in. sizes for domestic and commercial installations. Controls for gas and gas-oil fired heating plants are also made in sizes 8- through 32-in. Information is available. ---------- **Item 122**

**CONDENSATION PUMPS.** Page 33. The condensation pump and receiver offered by this company has a low inlet connection; operates quietly; and the impeller is a bronze centrifugal closed type. Designed for handling hot condensate, the entire unit can be removed for inspection or repair without disturbing piping connections. It is furnished in single or duplex. Bulletin is available. ---------- **Item 123**

**UNDERGROUND PIPE INSULATION.** Page 34. A special blend of a natural hydrocarbon which fuses itself to pipe and forms a protective coating of insulation is offered by this company. It can be used for hot or cold liquids or vapors and protects pipe from heat loss and corrosion. Information is available. ---------- **Item 124**

**RADIANT BASEBOARDS.** Page 35. Radiant baseboards are made by this company for use in schools, hospitals, institutions, and other large area heating applications. The baseboard is made of heavy gage steel, die-formed with rounded edges. Information is available. ---------- **Item 125**

**HEATING SYSTEMS.** Page 36-37. The line of heating equipment offered by this manufacturer includes finned tube radiators, unit heaters, vacuum pumps, temperature controls, and heating specialties. Convectors made by the company provide individual room temperature control. Bulletin is available. ---------- **Item 126**

**AIR DIFFUSERS.** Page 38. Square and rectangular air diffusers are made by this company with built-in diffusing vanes arranged in unlimited louver patterns. A catalog showing how to select the proper size and air pattern is available... **Item 127**

**EXPANSION JOINTS.** Page 39. Fewer joints per length of line are required by large steam distribution systems when this company's slip-type expansion joints are used. Made with traverses up to 12 in. single and 24 in. double, the joints may be packed under full steam pressure on the job. There is a lower pressure load on the end anchors. Bulletin is available. ---------- **Item 128**

**LINE OF PUMPS.** Page 40. A line of pumps offered by this company for plumbing, heating, and air conditioning systems includes a double suction horizontally split case pump, a close coupled pump, and a pedestal mounted, flexible coupled pump. Bulletins with the specifications of each pump in the line are available... **Item 129**

**PACKAGED AIR CONDITIONERS.** Page 41. Packaged air conditioners are available from this company in 3, 5, 7½, and 10-hp sizes. Open-type condensing units are also available in a wide range of sizes from ¼ to 100 hp. Information is available. ---------- **Item 130**

**HEATING — COOLING COMBINATION.** Page 42-43. The heating-cooling combination offered by this company consists of a duct cooling system independent of the heating system and a forced hot water baseboard heating system. A central thermostat permits choice of full cooling in hot weather. Information is available. ---------- **Item 131**

**SUSPENDED COOLER.** Page 45. An air conditioning unit for remote installations on new or old construction requires no floor space and can be used with Freon or with hot and cold water. The unit can be installed in vestibules, overhead entrance ways, plenums, closets, or hallways with or without false or furred ceilings. Bulletin and specification are available ---------- **Item 132**

**DUCT FANS.** Page 46. Two of this company's 24-in. belt-drive duct fans remove welding smoke and paint fumes along a high speed barrel production line. Single, double, or multiblade models are available from 12 to 60 in. for moving flammable fumes, corrosive elements or abrasive dust. Bulletin is available. ---------- **Item 133**

**AIR CONTROL MANUAL.** Page 47. An engineering manual for the control of in-plant environment in foundries is published by this organization. The manual's material is divided into eleven sections, including figures, tables, and numerous equations ---------- **Item 134**

**PACKAGED AIR CONDITIONERS.** Page 48. Six of this company's packaged air conditioners cool 20,000 sq ft, divided into five zones, in a Texas office. The air conditioners are available in ceiling models from 3 to 7½ ton and in floor models from 3 to 15 ton. Data on the units is available. ---------- **Item 135**

**FINNED TRANSFER SURFACE.** Page 49. Increase the turbulence of air flowing over a surface and heat transfer from that surface is increased. This company's finned heat transfer surface is manufactured for the company's air conditioning and refrigeration equipment. Bulletin is available. ---------- **Item 136**

**HEATING-VENTILATING LINE.** Page 52-53. The line of heating and ventilating products offered by this company includes horizontal, vertical, and gas-fired unit heaters; console heaters; air conditioning units; convectors; centrifugal fans; finned radiators; propeller fans and classroom unit ventilators. Engineering catalogs with data on each of the company's products are available. ---------- **Item 137**

**TEMPERATURE REGULATORS.** Page 54. When installing a new or replacing an old temperature regulator, look for packless constuction; a guarantee against wire drawing; a broad control range; easy maintenance; double duty and self-operation. This manufacturer's regulators offer all these features and more. Bulletin on temperature regulators is available. ---------- **Item 138**

**MOTOR-COMPRESSORS.** Page 55. Motor-compressors for packaged air conditioners are available from this manufacturer in ½, ¾, and 1-hp models using Freon-12 and ½, ¾, 1, and 1½-hp models using Freon-22. For larger capacities, dual systems are available. Performance data and costs are available. ---------- **Item 139**

**EXPANSION VALVES.** Page 57. A small-fixture thermal valve is made by this company to prevent motor overload and may be installed in any position in or out of the refrigerated area. It is liquid charged and available in 9 sizes for Freon 12, Freon 22, and methyl-chloride. Information is available. ---------- **Item 140**

**AIR FILTER SERVICE.** Page 58. This manufacturer offers to send a field engineer who is an air filtration expert, to analyze air filters and submit a factual, written report on his findings. The company makes this service available on a no cost basis because it will point out the importance of buying standard brand filters. Information on service is available. ---------- **Item 141**

**COAL STOKERS.** Page 59. Continuous ash discharge spreader stoker firing is offered to users of medium and small size steam generators by this stoker manufacturer. Sizes are available to develop from approximately 5,000 to 75,000 lb per hr of steam. Information is available... **Item 142**

**MAIN STEAM VALVES.** Page 60. Two 250-lb iron body angle valves were installed in 1915 on the main steam leads from boilers of a Wisconsin plant. In 40 years of uninterrupted service, the valves never failed to operate properly nor cause a shutdown. In all grades the manufacturer's iron castings exceed requirements of equivalent ASTM specifications. Its line includes gates, globes, angles, and checks. Assistance in ordering is offered... **Item 143**

**AIR COOLED CONDENSERS.** Page 61. Air-cooled condensers are available from this company in capacities up to 20 tons. The units have steel cases and are available arranged with either blower or propeller fans. Engineering and application assistance is offered. ---------- **Item 144**

**ELECTRIC MOTORS.** Page 62. A complete line of single and polyphase motors is available from this company in repulsion-start or capacitor-start types, open or totally enclosed, sleeve or ball bearing, with rigid or resilient basis or machined end bases for flange mountings. Bulletin is available. ---------- **Item 145**

**PRACTICAL PIPING LAYOUTS.** Page 63. How to plan piping connections for all-year air conditioning with a heat pump is another in a series of practical piping layouts offered by a valve manufacturer. An enlarged diagram and description of the layout is available. ---------- **Item 146**



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BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 53, SEC. 34.9, P. L. & R., NEW YORK, N. Y.

AIR CONDITIONING, HEATING AND VENTILATING

93 WORTH STREET

NEW YORK 13, N. Y.

AD-DIGEST SERVICE

# Ad-Digest

**AIR-COOLED CONDENSERS.** Page 64. The addition of a temperature control to this company's air-cooled condenser makes the operation of an air conditioning system fully automatic at any outside temperature and eliminates manual changeover from season to season. The condensing system provides predetermined minimum heat pressure up to the expansion valve. Information is available. ..... **Item 147**

**HOT WATER GENERATOR.** Page 65. The hot water generator made by this company is lined with baked-on plastic which is heat resistant to 500 deg F and leaves a smooth, non-porous surface that is easy to clean. Hot water generators, heat exchangers, air receivers and storage vessels are offered by the company. A 34-page reference catalog is available. ..... **Item 148**

**AIR CONDITIONING SYSTEMS.** Page 66. Air conditioning systems are designed by this company with the experience of packaged air conditioning engineers. Advance principles of engineering leadership are offered for advice, consultation, and application to reduce system maintenance. Information is available. ..... **Item 149**

**WATER TUBE BENDS BY HAND.** Page 67. Soft temper copper water tube for radiant heating jobs can be bent by hand. Its long 60 and 100-foot lengths require fewer joints. It can be joined with leak-proof solder-joint fittings using standard soldering techniques. ..... **Item 150**

**GLASS FIBER INSULATION.** Page 68. Glass fiber insulation is made by this company to meet the insulating requirements of manufacturers and installers of furnaces, air conditioners, and related duct work. The flexible insulation is held to panels by an adhesive. Bulletins are available. ..... **Item 151**

**AIR CONDITIONING LINE.** Page 69. The line of air conditioning equipment made by this company includes evaporative condensers and cooling towers to 100 tons, condensing units to 100 tons, packaged units to 50 tons, packaged liquid chillers with room console units, and packaged air-cooled units for residential and commercial applications. Information is available. ..... **Item 152**

**STORAGE HEATERS.** Page 71. The copper-lined storage heaters made by this company have rolled joints for 12 in. around the circumference to allow for longitudinal expansion. A special vacuum breaker protects the lining from sudden pressure fluctuations. A fabricating procedure file on the heaters is available. ..... **Item 153**

**SNOW REMOVAL TUBING.** Page 121. Copper water tube for snow melting panels can be bent to conform to the terrain and is available in 60-ft lengths. Copper tube cannot rust, rot, or deteriorate. Technical advisory service and a 16mm motion picture are available. ..... **Item 154**

**UNDERGROUND PIPE INSULATION.** Page 123. This triple-zone, hot underground pipe insulation consists of an inner semi-plastic core fused on by the pipe's heat, a middle sintered zone of particles, and a final zone of granule thermal insulation. It is installed by pouring, tamping down, and back filling. Information is available. ..... **Item 155**

**POWER PLANT FUEL.** Page 125. Modern bituminous coal burning equipment can give 10 to 40% more steam per dollar. Automatic coal and ash handling systems can cut labor costs. Coal is safe to store and use. Information and case histories of how plants saved money are available. ..... **Item 156**

**AIR CONDITIONING EQUIPMENT.** Page 127. The line of air conditioning equipment offered by this company includes a hermetic centrifugal refrigerating machine, central-station air conditioners, multi-zone air conditioners and packaged air conditioners from 3 to 20 tons. The refrigerating machine is a single-stage unit that requries no built-up bases. Bulletin is available. ..... **Item 157**

**Circle numbers corresponding to the items and advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.**

**ROTARY OIL BURNERS.** Page 131. The rotary oil burners are equipped by this company with a heater that automatically warms heavy oil and a magnetic valve that passes the oil to the nozzle when it is warm enough. The burner can be combined with the company's gas burner to provide a dual-fuel firing system. Literature and specification sheets are available. **Item 158**

**DRAFT INDUCERS.** Page 133. Motorized draft inducers are manufactured by this company to solve the draft requirements of modern schools. The only chimney needed is a stub stack to vent exhaust gases. A special schools bulletin and a bulletin on the draft inducer are available. ..... **Item 159**

**SPACE HEATERS.** Page 135. Twenty-five of this company's counterflow space heaters cut the heating cost of one plant to less than half of the former system. The twenty-five units provide 21.7 million Btu per hr to the six-acre plant area. Literature is available. ..... **Item 160**

**AUTOMATIC CONTROLS.** Page 137. The automatic controls made by this company were chosen by a new shopping center to control center fan systems, unit heaters, multi-zone units, and packaged air conditioners. The controls are electric-electronic types with positive positioning. Information is available. ..... **Item 161**

**RIB-TYPE MOTORS.** Page 139. A complete line of rib-type motors from 1- to 100-hp is offered by this manufacturer. The rib-type design provides reserve cooling capacity in dirty locations. Large grease reservoirs surround the motor's bearings. Information is available. ..... **Item 162**

**BRONZE VALVES.** Page 141. Fourteen different sizes of handwheels are all that is needed for fifty lines of gate, globe, and angle valves, involving 420 individual valves made by this company. The company's system of interchangeability of parts for bronze valves permits a small inventory of basic parts. Literature is available. ..... **Item 163**

**STEAM GENERATORS.** Page 143. Thirty-nine stores in a modern shopping center are hooked into a heating circuit powered by three of this company's steam generators. They are equipped with full modulation, and each cuts in automatically only as the load demands. Information is available. ..... **Item 164**

**REGISTERS AND GRILLES.** Page 145. This company's line of registers and grilles includes perimeter baseboard diffusers, perimeter baseboard registers, perimeter floor registers, and ceiling air diffusers. Catalog is available. ..... **Item 165**

**AIR HANDLING UNITS.** Page 147. Air handling combination units are available in thirteen basic sizes from this company with capacities from 500 to 48,500 cfm. Each unit is available with a choice of two coil face areas in five coil types and accessories as required. Application service is available. ..... **Item 166**

**AIR RECOVERY CELLS.** Page 149. Air recovery cells were installed in the air conditioning system of a photographic printing paper plant to remove minute quantities of phosphorous from the air which were spoiling the paper. Air recovery cells in any air conditioning or ventilating system will reduce needed amount of outside air and needed heating and cooling capacity. Information is available. ..... **Item 167**

**THREADLESS VALVES.** Page 149. Threadless valves for silver brazed joints in copper or brass piping are offered by this manufacturer. Solder end threadless valves for soldered joints are also available in globes, gates, and checks. A catalog with cutaways, details, and specifications is available. ..... **Item 168**

**PACKLESS EXPANSION JOINTS.** Page 151. Packless expansion joints are made by this manufacturer with equalizing rings to absorb four different motions. The company's engineering experience is applied to every pipe problem presented to it. Bulletin is available. ..... **Item 169**

**ICE BANKS.** Page 151. Sweet water ice banks are designed by this manufacturer to deliver tons of 32- to 34-deg F ice water for recirculation through air cooling coils in air conditioning systems. Designed for use with Freon, methyl chloride, or ammonia, the banks may be added to existing systems for increased capacity. Catalog is available. ..... **Item 170**

**VENTILATION MANUAL.** Page 153. The fourth official edition of an industrial ventilation manual has been enlarged, improved, and includes many new tables. It contains the information needed for the design of industrial ventilation systems. ..... **Item 171**

**DIRECT FIRED HEATER.** Page 153. A unit with a stainless steel combustion chamber of floating design which eliminates undue expansion and contraction stresses. Information available. ..... **Item 172**



## INQUIRY CARD

**Circle below item numbers on which you wish catalogs or further information.**

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**PLEASE PRINT** May H-56

This service available only to U. S. and Canadian readers.

**Name** ..... **Title** .....

**Firm** .....

**Nature of Firm's Business** .....

**Street** .....

**City** ..... **Zone** ..... **State** .....

This card is void after Aug. 1, 1956

# Ad-Digest

**VENTILATORS.** Page 154. This company's ventilators have been used for the ventilation of schools incorporated with interior duct systems or for general spot ventilation. The ventilators are styled low and attractive to blend with modern architecture. Information is available. ---**Item 173**

**POWER BOILERS.** Page 155. Power boilers are manufactured by this company to satisfy the demands of institutional, apartment, office and industrial buildings. The company also furnishes low pressure boilers for heating purposes. Information is available. ----------**Item 174**

**UNIT AIR CONDITIONERS.** Page 155. Unit air conditioners are furnished by this manufacturer in sizes of 3, 5, and 7½ hp. They have insulated cabinets; large cooling surfaces; insulated condensers; and conservative ratings. Bulletin is available. ----------**Item 175**

**CENTRIFUGAL PUMPS.** Page 156. Close-coupled centrifugal pumps are manufactured by this company for all air conditioning and refrigeration installations. Designed for continuous duty, the pumps are available in heavy duty models from 1/3 to 7½ hp. Submersible pumps are also available for deep well cooling systems from 1/3 to 275 hp. Catalog is available. ----------**Item 176**

**AIR DUCT HEATERS.** Page 157. Controlled temperatures to 1000 deg F can be maintained by electric air duct heaters for heating air and gases under forced circulation. Installed in round or rectangular ducts, the heaters may be used for drying, curing, baking, and annealing ovens. Catalog is available. ----------**Item 177**

**POWER ROOF VENTILATORS.** Page 157. Power roof ventilators are available from this company all with air capacities from 550 to 65,000 cfm belt and direct drive. Seven top view sizes are available in 6-in. increments; height varies in 5½-in. increments. Booklet with design, construction and performance data is available. ----------**Item 178**

**1956 DIFFUSER CATALOG.** Page 157. The 1956 edition of this company's catalog lists over 1000 sizes and designs of registers, grilles, and diffusers for heating and air conditioning. The 32-page catalog also contains descriptions of dampers and extractors. Copies are available. ---------**Item 179**

**HEAVY-OIL BURNER.** Page 158. Oil burners designed for heating buildings that require more than 6000 gallons of oil or 45 tons of coal per year will burn commercial No. 4 or 5 heavy oils. Conversion is simple; the burner fits all types of standard heating boilers. Illustrated bulletin available for those who own, specify, install, or service burners. ----------**Item 180**

**WATER HAMMER ABSORBERS.** Page 159. The shock absorbers made by this company eliminate noisy water hammer in pipe lines and prevent damage to valves, fittings, and pipe lines. Shock absorber manual is available. ----------**Item 181**

**PRODUCT COOLERS.** Page 159. Product coolers are available for any given temperature needs, for both wet and dry operation. Water and hot gas defrost can be furnished in addition to custom engineered units. Catalog is available. **Item 182**

**INTERIOR FIRE PROTECTION.** Page 159. Contractors' success stories on interior fire protection jobs indicate there is a reason why this manufacturer's line of interior fire protection equipment is preferred. Check with the company's representative before figuring on the next interior fire protection job. ----------**Item 183**

**SECTIONAL CONDENSER.** Page 160. The casing of this company's condenser is made of sections each separately removable to give access to all parts. The unit removes superheat before condensing and keeps the system purged of oil. Capacity range is from 90 to 240 tons. Bulletin is available. ----------**Item 184**

**WATER COOLER GUIDE.** Page 161. A new guide to water cooler selection, published by this company, answers such questions as: Type required; kind needed; capacity necessary; how many; and location. It also considers how much water is needed by office, factory, and foundry workers. ----------**Item 185**

**REFRIGERANT INDICATORS.** Page 161. Refrigerant indicators are made by this company in sizes ¼ or ⅜ in. for small air conditioners or refrigerators and in sizes to 1⅜ in. for large size commercial installations. The indicators have a pyrex glass window and are guaranteed to 500 psi. Catalog is available. ----------**Item 186**

**AIR CONDITIONING ENGINEERS.** Page 161. Opportunities for engineers with air conditioning experience to work on high speed aircraft, rocket, and missile projects are offered by this company. Experience in high and low velocity air or liquid piping systems, jet pumps, heat transfer in structures, or fans is desirable. Information is available. ----------**Item 187**

**BOILER WATER LEVEL CONTROLS.** Page 162. A permanent Alnico magnet is located outside the float chamber of these water level controls. Units are available for temperatures to 750 deg F and pressures to 600 psi for single stage or multi-level stage service with as many as three separate switching actions. Catalog is available. ----------**Item 188**

**AIR FILTER GAGES.** Page 163. Air filter gages are offered in three types by this company: An inclined tube type; a diaphragm actuated dial type; and a bell actuated dial type. The company's line also includes: draft gages, pitot tubes, and portable gas analyzers. Bulletin is available. ----------**Item 189**

**VENTILATORS.** Page 163. Twenty-nine of this company's 72-in. fan ventilators with individual capacities of 81,000 cfm exhaust large volumes of fumes and heated air from a steel plant during certain operations and lesser amounts during others. A data book on the company's line of roof ventilators is available. ----------**Item 190**

**LIQUID DEPTH GAGES.** Page 164. Remote reading tank gages are available in four models from this company to suit almost every industrial installation. The gages can be installed on tanks above or below the ground and up to one-quarter of a mile away. They can be obtained in multiple units on a single panel and mounting plate. Bulletin is available. ..**Item 191**

**INDUSTRIAL UNIT HEATERS.** Page 165. Twelve basic sizes of industrial unit heaters—1-, 2-, and 3-fan models—are made by this company with capacities from 83,000 to 1,735,000 Btu per hr, handling from 2000 to 28,000 cfm. A choice of ten heating elements is offered for every size unit. Publication with data on the heaters is available. ----------**Item 192**

**PACKAGE CHILLERS.** Page 166. Package chillers are made to meet the requirements of residential, commercial, institutional or industrial installations by this manufacturer. The chillers have completely non-ferrous water passages to guard against corrosion. Bulletins describing the various chillers made by the company are available. ----------**Item 193**

**COOLING TOWERS.** Page 168. One of this company's towers keeps gasket metal rolls within 5 deg F tolerances. Cooling towers of all types are manufactured by this company from small residential types with 3-gpm capacities to towers with 15,000-gpm capacities. Engineering help is available. ----------**Item 194**

**PORTABLE EQUIPMENT HOISTS.** Page 169. A portable hoist is available from this company that enables two men to raise all types of equipment from 200 to 4,000 lb. up to 18 ft. in one hour. Information and price is available. ----------**Item 195**

**AUTOMATIC SHUTTER.** Page 169. An automatic shutter for unit blowers is self-contained in an adapter sleeve for attachment to the blower. Weather stripped, the shutter has light gage aluminum louvers with felt silencer strips. Catalog, circular, and prices are available. ----------**Item 196**

**AIR CONDITIONING SYSTEMS.** Page 169. This company's air conditioning systems are being installed in a wide variety of Florida clubs, motor hotels, shopping centers, and stations. The systems have advantages to meet any requirement. Catalogs are available. ----------**Item 197**

**APPLICATION ENGINEER.** Page 170. An opportunity for a mechanical engineer with five or more years' experience in the design of air conditioning and refrigeration systems is offered by this company. Some of this experience must be in high pressure systems. Send detailed resume. ----------**Item 198**

**WING CAP VALVES.** Inside Back Cover. Semi-steel, wing cap valves are made by this company with five types of connections: FPT in valve butt; OD soldered brass adapter and steel flange; steel butt weld adapter and steel flange; one piece FPT flange; and one piece slip-on weld flange. Information is available. ..**Item 199**

**BOILER CONTROLS.** Back Cover. For boilers up to 250 psi, this company's series of controls provides pump control, low water fuel cutoff, and low water alarm. Two models are available with either self-contained water column bodies or for installation with independent water column. Engineering folder and wiring sheets are available. ----------**Item 200**



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AIR CONDITIONING, HEATING AND VENTILATING'S

# Application of the Packaged Heat Pump

WALTER R. YEARY
Air Conditioning Div., Westinghouse Electric Corp., Staunton, Va.

**Pointers on how to achieve economies in the installation and operation of packaged heat pumps and how to make the necessary computations for estimating operating loads and costs.**

**AIR CONDITIONING, HEATING AND VENTILATING — MAY, 1956**

# Application of the Packaged Heat Pump

WALTER R. YEARY

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**Rapid progress has been made with the packaged heat pump for year-round air conditioning and the industry is optimistic regarding greater acceptance of this unit. Various type units are available; the operating cycles for each are described and illustrated in this article. Problems are included to show how to estimate the cooling and heating loads, with and without the use of strip heaters for balance, and also how to estimate operating costs. There are pointers on where and how to install the heat pump, and how to reduce first and operating costs to gain greater economies in installation and operation.**

ESSENTIALLY, the heat pump is a conventional air conditioner with self-contained arrangements for reversing the direction of flow of either the refrigerant or the heat transfer medium, which may be water or air, so that the system may be made to perform at one time as an air cooler and at another time as an air heater. Air cooling is simply the removal of heat from one location and dissipating this heat into another zone. With the reversal of the refrigerant or the transfer medium, the source of heat is also reversed.

Heat will transfer from a warmer object to a colder one even when the temperature difference between the two objects is less than one degree. Gases, liquids and solids contain some heat until they reach the temperature of absolute zero or —460 deg F.

By proper application of the refrigerating system, it is possible to maintain a fairly constant temperature difference between the refrigerant, or transfer medium, and the higher temperature of the heat source. Heat will then transfer from the source in an amount equal to the heat contained in the source, between the temperatures of the source and the medium, less losses incurred by reason of mechanical imperfections and the natural difficulty in extracting the total heat from any source. If it were possible to extract the total heat from the source air entering the outdoor coil of an air-to-air heat pump at, for example, 17 deg, the discharge air would have a temperature of approximately absolute zero or —460 deg. It is reasonably doubtful that this will ever be accomplished with a heat pump.

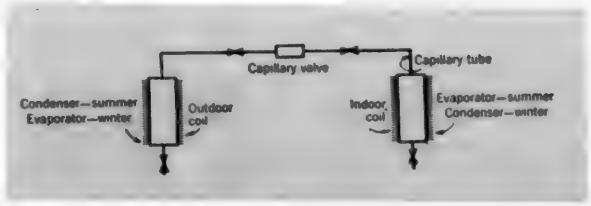



Fig. 2. Seasonal function of outdoor and indoor coils with air-to-air heat pump.

Therefore, on the heating cycle, the heat source is the outdoor air, water or ground (see Fig. 1) and on the cooling cycle, the space to be cooled is the source of heat.

Refrigerants and transfer mediums cannot permanently store within themselves the heat removed from an outside source or a conditioned space. Such heat must be disposed of in some manner in the same proportion that it is acquired. Therefore, for every source of heat there must be a sink or a place for heat disposal. For summer cooling with a heat pump, the sink may be the outdoor air (air-cooled condenser), a watercooled condenser, the ground, a river, or, with a few exceptions, any of the same media used as a source during the winter.

Thus, the year-round operating sequence of the heat pump follows: In summer, heat is removed from the space (source) and it is released into the ground, outdoor air, or water (sink). In winter, heat is extracted from outdoor

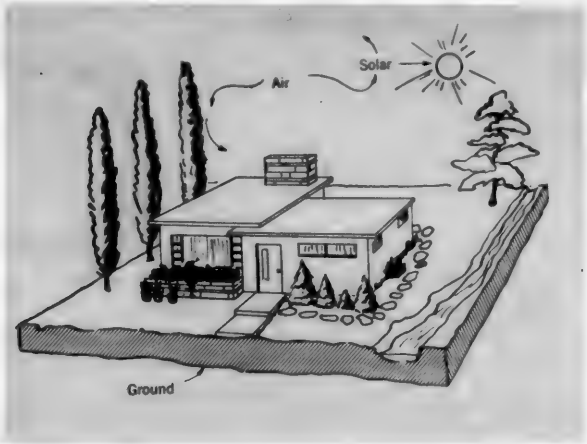



Fig. 1. Sources of heat and heat sinks outside the house. Solar energy cannot be used as a sink.

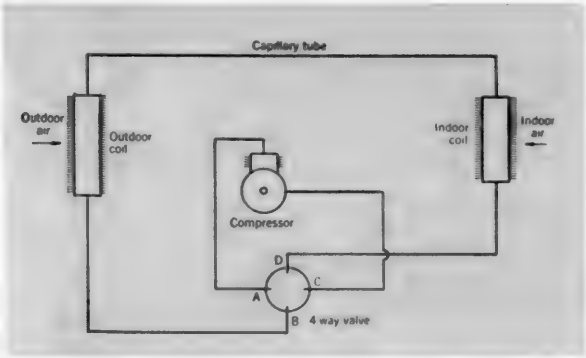



Fig. 3. Basic circuit of air-to-air heat pump.

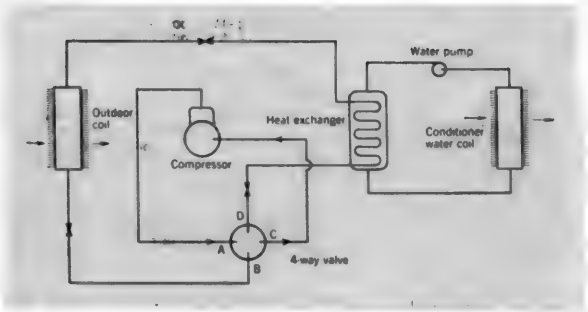



Fig. 4. Basic circuit of air-to-water (to-air) heat pump.

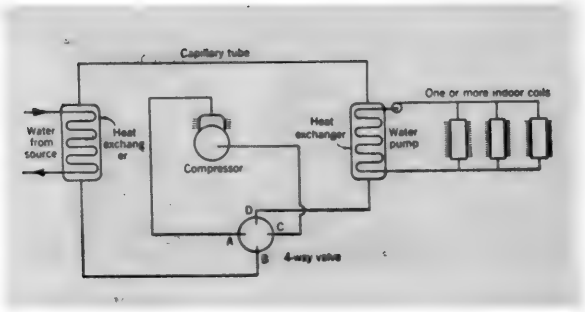



Fig. 6. Basic circuit of water-to-water heat pump.

air, water or ground (source), and released into the space (sink). In effect, the heat pump cools the space in summer and heats the sink, and in winter it heats the space (sink) and cools the outdoor source of heat.

A self-contained air-to-air heat pump is equipped with an indoor coil and an outdoor coil. The indoor coil serves in summer as a cooling coil or an evaporator; in winter it serves as an air-cooled condenser. The outdoor coil serves in summer as an air-cooled condenser, and in winter as an evaporator as shown in Fig. 2. The reversal of the refrigerant is accomplished, in most heat pumps, by means of a special 4-way valve which changes the direction of refrigerant flow according to the demand of the space thermostat for heating or cooling. The direction of refrigerant flow through the compressor of the unit is never reversed. Direction of flow is reversed only in the circuit external to the compressor.

In other types of heat pumps, the direction of refrigerant flow is never changed in any part of the refrigerant circuit. These types use a second medium of transfer, usually water containing an anti-freeze solution, and only the direction of this medium is reversed.

## Types of Heat Pumps

There are six common types of heat pumps now in use in this country. They are, by classification: air-to-air, Fig. 3; air-to-water, Fig. 4; water-to-air, Fig. 5; water-to-water, Fig. 6; earth-to-air, Fig. 7, and earth-to-water. These designations simply mean that heat is taken from the source, transferred to the refrigerant as the first medium, and then transferred from the refrigerant to air or water as the second medium. The latter medium is then circulated into the space (air) or, if water, it is circulated through convectors or radiators located within the space.

There are some industrial and commercial installations which use water-to-refrigerant-to-water-to-air systems. A few others use the same sequence of heat transfer except that outdoor air is the primary source of heat. The three primary sources of heat have been previously mentioned as air, water and earth, which may be used alone. Other sources include solar radiation, sewage, process waste heat and industrial flue gas heat. Solar energy, while having tremendous potentiality, will probably be developed as an auxiliary to the first three, and is already used extensively in the lower southern states for domestic water heating. Considerable research is under way leading to the full utilization of solar heat for heat pump purposes, it may be some time before this is actually accomplished. Waste heat, sewage, and flue gas heat have been used in some cases, but have not been used extensively. Flue gas heat from industrial chimneys should be a prime source of heat since many boiler rooms operate twenty-four hours per day, and this is most suitable for heat pump use.

## Coefficient of Performance

The operating efficiency of any heat pump is measured by what is commonly called the Coefficient of Performance, or simply, the COP. To better understand the COP, observe that there are two principal sources of heat which must be rejected by the condenser of a heat pump during summer operation. They are (1) heat from the room air being circulated across the indoor coil, and (2) heat from the mechanical equivalent of the electrical input to the compressor. In winter operation, the heat pump indoor coil will supply the equivalent of the electrical input plus the heat taken from the outside heat source. The heat energy obtained from the outside source is obtained as a

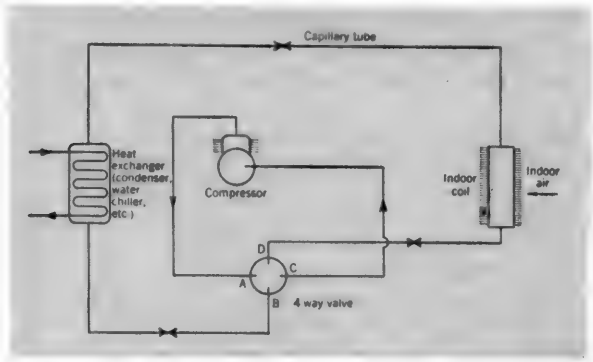



Fig. 5. Basic circuit of water-to-air (liquid-to-air) heat pump.

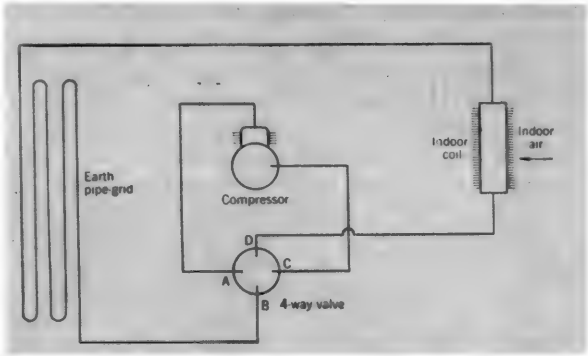



Fig. 7. Basic circuit of earth-to-air heat pump. By substituting a refrigerant-to-liquid heat exchanger in place of the indoor coil, the circuit becomes an earth-to-water system.

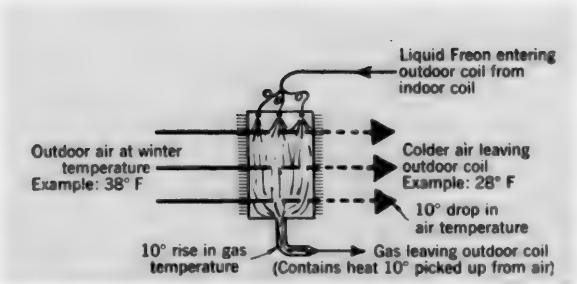

Liquid Freon entering outdoor coil from indoor coil
Outdoor air at winter temperature Example: 38° F
Colder air leaving outdoor coil Example: 28° F
10° drop in air temperature
10° rise in gas temperature
Gas leaving outdoor coil (Contains heat 10° picked up from air)

Fig. 8. Transfer of heat from outdoor air into the refrigerant in the outdoor coil of an air-to-air heat pump.

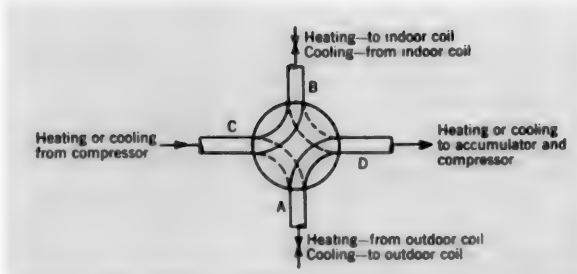



Fig. 9. Principle of a four-way reversing valve, shown in the heating position.

by-product from the electrical energy input to the compressor. As a result, the cost of operation is that of electrical energy only, and the additional heat from the outside is, so to speak, free.

If the heating capacity, $Q_1$, of a certain heat pump, operating at 35 deg outdoor temperature and 70 deg air entering the indoor coil, is 54,000 Btu per hr, and the value of the electrical input, $Q_2$ is 20,137 Btu (5.9 kw), then:

$$\text{COP} = \frac{Q_1}{Q_2} = \frac{54{,}000}{20{,}137} = 2.9$$

The COP of 2.9 represents the ratio of total heat obtained at the indoor coil to the heat paid for in the form of electrical energy input to the unit. In other words, the amount of heat obtained is equal to 2.9 times the electrical energy applied to the heat pump.

The average coefficient of performance of most packaged type units at 35 deg outdoor temperature, and 70 deg air entering the indoor coil, is about 3.0, but may be lower or higher. A COP as high as 4.0 or 5.0 is rare and, when it does occur, is usually found in large field-assembled systems. The coefficient of performance decreases as the outdoor temperature declines.

The value $Q_2$ does not include the electrical input of supplemental heating since we are interested in the COP of the heat pump alone. Naturally, if supplemental heating electrical input is added to $Q_2$, a false COP will result; that is, it would be a false COP insofar as the ratio of input to capacity of the heat pump compressor plus the heat from the source is concerned. Supplemental heat required to obtain sufficient capacity to heat a space at the lower temperatures is not a part of the actual heat pump capacity since it may be added in any one of a number of different ways.

### How the Heat Pump Operates

The air-to-air type packaged heat pump is by far the most popular of the self-contained units being manufactured for residential use. It is much easier to understand this type heat pump, if one notes that the unit is a typical air-cooled air conditioner during the summer cycle, with the outdoor coil serving as the air-cooled condenser and the indoor coil serving as the evaporator or cooling coil. By proper control of the 4-way valve, the use of a reversible capillary tube and valve, and a combination cooling-heating thermostat, refrigerant flow is reversed in the circuit external to the compressor. The indoor coil becomes an air-cooled condenser and the outdoor coil becomes an evaporator or outdoor cooling coil as shown in Fig. 8.

The refrigerant circulated through the outdoor coil in winter is at a very cold temperature—normally much colder than the outdoor air. Thus, obeying the law of heat transfer, heat contained in the outdoor air transfers into the refrigerant through the fins and tubes of the coil.

The capillary tube and valve act as a restricting or metering device and the liquid refrigerant is forced to expand and lose pressure as it is fed into the larger internal area of the outdoor coil. The action of the refrigerant is the same or similar to that taking place when it enters the indoor coil during the cooling cycle. Due to this expansion and reduction in pressure, the refrigerant begins to boil and evaporate. Because of evaporation, refrigerant temperature is reduced below the temperature of the outdoor air moving across the coil, and heat transfers from the air into the refrigerant. The outdoor coil is thus functioning as an evaporator or cooling coil. Air discharged from the coil will be colder than the entering air because heat has been extracted from it.

In this action, the liquid refrigerant is changed to a gas and is drawn toward the compressor by reason of the low pressure existing on the suction side of the compressor. Before entering the compressor, the gas must pass through the 4-way valve, Fig. 9, which serves the very important function of directing the flow of the refrigerant as previously explained.

During the heating cycle, the position of the valve in Fig. 9 is such that it is open between ports *A* and *B*, and *D* and *C*. Low-temperature gas enters the valve through port *D* and leaves through port *C*. High-temperature, high-pressure gas enters the valve through port *A* and leaves through port *B*. In the cooling position, the valve ports are open between *A* and *D*, and *B* and *C*.

After passing out of port *C* the low temperature, low pressure gas enters an accumulator and from there it passes through a heat exchanger before entering the suction side of the compressor.

The refrigerant gas enters the compressor at the suction inlet, and in the case of most hermetics, travels through the compressor motor and up into the cylinder on the down-stroke of the piston. The up-stroke compresses the gas, and thus increases its temperature. This is where the equivalent energy of the electrical input to the compressor is picked up in the refrigerant stream. This additional heat is the heat of compression resulting from the work being done by the compressor as a result of the electrical input to the motor.

Heated refrigerant gas leaving the cylinder of the compressor is again directed through the 4-way valve and then into the indoor coil. Due to the lower temperature of the air being recirculated across the indoor coil, the refrig-

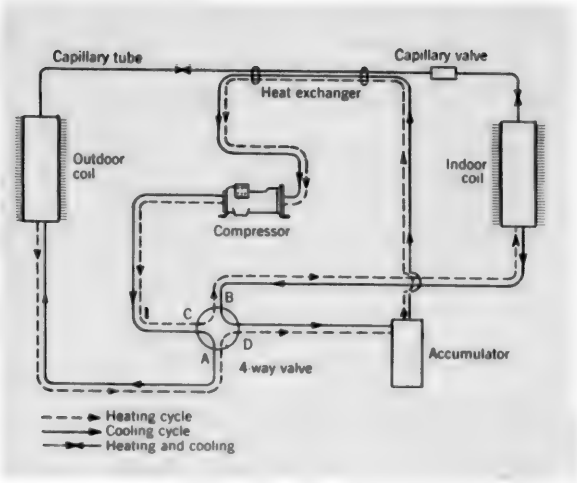



Fig. 10. A more detailed circuit of an air-to-air heat pump.

erant releases its heat into the tubes and fins of the coil and finally into the recirculated air. It is then carried into the conditioned space by the air stream and, again because of a lower temperature within the space, is released into the space. Thus, heating is accomplished by the air-to-air heat pump. The complete circuit is shown in Fig. 10.

The indoor coil is now functioning as a condenser because the cool air passing across it extracts heat from the refrigerant and condenses the gas to a liquid.

The liquid refrigerant next passes into the capillary tube and valve, Fig. 11, which is engineered to allow only the proper amount of liquid to enter the outdoor coil, or the indoor coil during the cooling cycle.

Entering the outdoor coil, the refrigerant is again evaporated, picking up heat, and continuing through the system repeating the cycle.

## Cooling Cycle

When the thermostat calls for cooling, the 4-way valve automatically repositions itself so that ports *A* and *D*, and *B* and *C* are open to each other respectively. This changeover may be fairly quick with prompt response in the reversal from heating to cooling. As a matter of fact, the reversal may be so quick and noiseless that the average home-owner may never know when it occurs. During late spring or early fall, the unit may reverse two or three times in a 24-hour period yet maintain an indoor temperature so constant that occupants of the house may never recognize the changeover.

After the valve changeover, the refrigerant will flow as a liquid from the outdoor coil (now functioning as an air-cooled condenser), through the capillary tube and valve, into the indoor coil. Here its pressure is reduced due to expansion, and evaporation occurs, causing heat from the space to transfer into the colder refrigerant. The gas then leaves the indoor coil, passes from port *B* to port *C* of the 4-way valve, through the heat exchanger, and into the compressor at the suction inlet. Compression again occurs, picking up the equivalent heat of the electrical energy input to the compressor, and the hot gas enters the 4-way valve at port *A*, leaves through port *D*, and enters the outdoor coil where it is again condensed to a liquid.

In the condenser, the gas gives up the heat to the out-

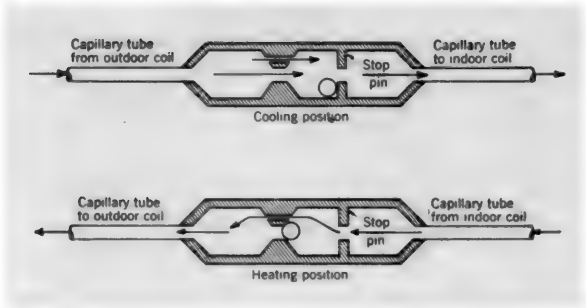



Fig. 11. Capillary tube and valve. More refrigerant passes through the valve during the cooling cycle than during the heating cycle. The ball check effectively blocks flow in heating position.

door air being circulated across the coil. Leaving the outdoor coil, the liquid refrigerant enters the capillary tube in the reverse direction and the cycle is repeated.

Figure 10 indicates the direction of refrigerant flow in both the cooling and the heating cycles. It shows that the direction of refrigerant flow through the compressor never changes, but flows in one direction during both cycles. The air-to-air, self-contained heat pump is simply an air-cooled air conditioner in which a reversal of the refrigerant flow in the circuit external to the compressor will provide heating and cooling upon demand of the summer-winter thermostat.

## Heat Pump Installation

Application of the self-contained heat pump is very similar to that for conventional air-cooled air conditioning equipment. With only a few detailed pointers and bits of information, the average installer experienced in conventional air conditioning application should be able effectively and successfully to apply the heat pump.

Air-to-air heat pump installation is much simpler than for an air-cooled conditioner using a remote condenser. There is no external refrigerant piping connected with the packaged type heat pump. All piping is completed at the factory since the outdoor air coil is an integral part of the packaged unit. Duct work between this coil and the outdoor air source is necessary. The amount of duct required depends upon the location of the unit. It is possible to locate the unit near or against an outside wall so that the only outdoor duct requirement is a collar through the wall to an outdoor grille. See Fig. 12.

Air-to-air heat pumps use no water. The only water piping necessary is a simple condensate drain. This drain is not tied into the sewer system but is simply dripped into the nearest drain or to the outdoors. The condensate drain from any type of air conditioner should be kept out of waste systems subject to any amount of pressure, unless a condensate pump provided with an anti-siphon device or check valve is used to prevent back-pressure in the drain pipe.

The air-to-air heat pump requires no fuel source other than a properly sized and installed electric power circuit.

Heat pumps using water or earth as an outdoor source and sink do require external water or refrigerant piping. Water source units circulate either water or refrigerant through piping installed in a well, river, lake, or some other body of water. Ground source units circulate refrigerant through a pipe grid buried in the ground below the frost line.

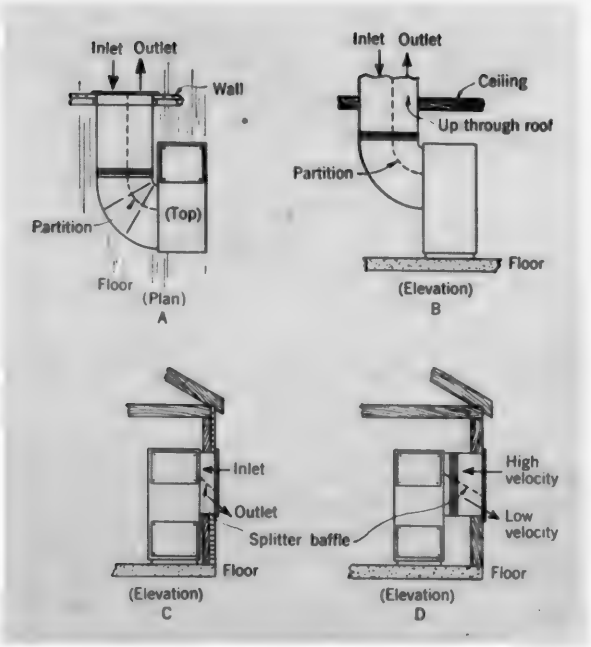



Fig. 12. Typical arrangements of duct work between the outdoor air coil and the outside air in an air-to-air heat pump.

Considerable difficulty has been experienced with ground source heat pumps due to expansion and contraction of the pipes in the ground grid. Expansion tends to push earth away from the pipes and, in many cases, it remains in the outermost position. Consequently, overall direct contact of the pipe with the ground, which is necessary for highest efficiency, is often lost. Heat transfer and coefficient of performance are thus reduced and impaired.

For overall performance and minimum maintenance requirements, the air-to-air packaged unit is considered best for residential and most commercial applications. Multiple unit applications are often made in larger buildings requiring considerable cooling tonnage. However, field-assembled systems are becoming very popular in the larger buildings. These large heat pumps are also defined as air-to-air, water-to-air, water-to-water, etc., depending upon the source of heat and type of primary and secondary mediums of heat transfer.

Type designations are often confusing, especially when one reads something like this: Water-to-refrigerant-to-water-to-air. The correct designation is simply, "water-to-air." Water is the source of heat in winter and the heat sink in summer; air is the heat sink in winter and the heat source in summer. Intermediate transfer mediums are seldom mentioned or shown in correct type designations.

By way if explanation, "water-to-refrigerant-to-water-to-air" for winter operation means this: Water is the source of heat; the heat is transferred from the water to refrigerant being circulated through a heat exchanger; the heat is then transferred from the refrigerant into water being circulated in another circuit; from the water in the latter circuit, the heat is transferred into the air being circulated through the conditioned space. See Figs. 4 and 6.

The refrigerant circuit is the primary medium of transfer and the last water circuit is the secondary medium of transfer. Air within the conditioned space is, besides being a source and sink, the final medium of transfer. Since air conditioning means the treatment of air in one way or another, the transfer of heat within the conditioned space is to or from air in any heat pump used for air conditioning.

Water-to-air systems may omit the secondary medium of heat transfer (water) and transfer directly from the refrigerant to the circulated air. The choice of the use of the secondary medium depends upon the type of system to be installed. If individual room units are to be used, then the secondary medium (chilled water) is most desirable. If one central cooling coil is used, the secondary medium may be omitted and the refrigerant circulated in a direct expansion coil instead. This arrangement usually decreases considerably the cost of accessory items. The direct expansion coil will function in the same manner the indoor coil functions in an air-to-air unit—as a direct expansion coil in summer and as a condenser in winter.

The efficiency and performance of well-engineered, field-assembled heat pumps should equal or exceed that of the smaller packaged units. The COP is usually much higher than for the packaged units.

The outdoor coil of an air-to-air heat pump is usually an integral part of the complete assembly within the cabinet and cannot be removed from it for remote installation.

The packaged heat pump should be installed so that the run of the outdoor airduct between the unit and the outside of the building is as short as physically possible.

After leaving the inlet and outlet location on the cabinet, the ducts should be sized to maintain air velocities in the inlet and outlet ducts as recommended by the manufacturer. Sizable deviations from recommendations may result in decreased coil capacity.

Where a partition is used in the outdoor air duct to separate the inlet and outlet air, rigid insulation should be applied to one or both sides of the partition. Rigid insulation may itself be used as the partition material. When using partioned duct, it is important that the inlet and outlet sections be sized to maintain recommended velocities. This construction will result in the partition being installed at an angle similar to that shown in Fig. 12 and will assure proper velocity of inlet and outlet air.

The inlet and outlet air ducts should be insulated if they exceed the bare minimum length. The minimum length would be that required where the heat pump is installed directly against an outside wall with the air inlet and outlet duct going directly through the wall. Duct runs any longer than this should be insulated with a minimum of 2 inches of good insulating material.

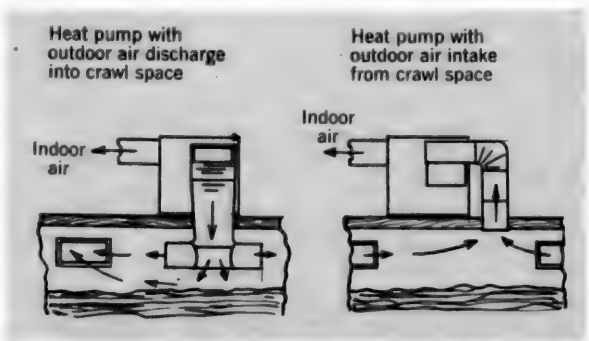

Heat pump with outdoor air discharge into crawl space
Heat pump with outdoor air intake from crawl space
Indoor air
Indoor air

Fig. 13. A crawl space may be used as an intake or a discharge area—never for both. Sketch shows crawl space used for discharge (left) or for intake area (right).

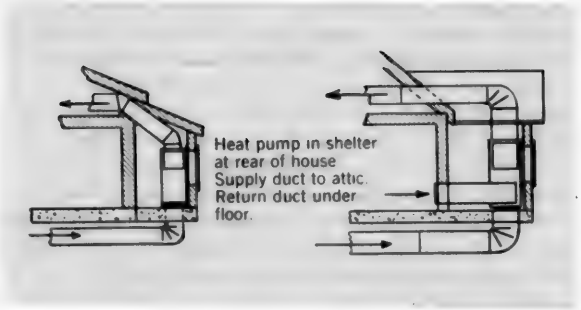



Fig. 14. Outdoor shelter for heat pump.

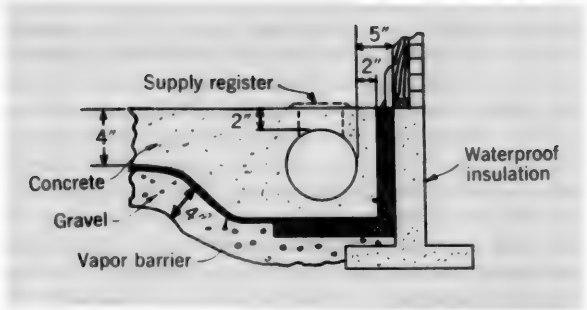



Fig. 15. Perimeter ducts need not be insulated when run in slab floors, but the edge of the floor should be insulated as shown.

The intake grille should be located as close to the house as possible to take advantage of the warmer air near the house during the winter. The exhaust outlet should be located to provide adequate clearance for the discharge air from the side of the house to avoid any recirculation of this air back into the inlet grille. When both inlet and outlet grilles are placed side-by-side on the outside of the wall, it is often necessary to install a splitter baffle between them to prevent discharge air recirculation.

The inlet and outlet openings of the grille should be covered with $\frac{3}{8}$ or $\frac{1}{2}$ in. mesh screen to avoid entry of obstructional objects. Fly screen should not be used.

Crawl space under a house may be used as an intake or discharge area, but the *same space must never be used for both purposes*. There must be sufficient ventilator free area and the ventilators must be left open **permanently.** The discharge duct must be taken down through the floor and turned to discharge horizontally between the floor and the ground, Fig. 13, so that the longest possible air throw may be obtained. A split discharge duct is recommended so that the outlet air may be discharged in two or more directions for better removal from the area. The inlet air duct may be attached directly to a collar and screen in the floor. The floor must be insulated in either case. Condenser discharge air will heat the space and floor in summer and cool it in winter. The movement of summer inlet air under the floor is desirable, but winter inlet air may have an undesirable cooling effect on uninsulated floors.

Filters will be required in the inlet duct when the location is subject to excessive dust conditions.

### Heat Pump Location

The packaged heat pump may be located in any convenient space providing there is an access way for the outside air ducts, sufficient space for indoor supply and return ducts, and if the floor is strong enough to support the weight of the unit.

Recommended locations are those along outside walls where outdoor air ducts may be taken directly through the wall.

Locations near the center of the house, offset to an outside wall, are preferred. These allow short runs of supply and return ducts with a consequent reduction in external static pressure and savings in duct and insulation costs.

A garage at the end of a large ranch type house is least preferred as a heat pump location due to the extended run of the indoor supply ducts to reach the far end of the house. Such a location often creates problems in maintaining as high a return air temperature as possible because of leaks in the duct and cold areas through which the duct may pass. For maximum heat pump performance, the temperature of the return air at the unit should be as close as possible to the temperature of the air at the return grille in the space.

Most air-to-air heat pumps operate with a temperature rise of approximately 30 deg across the indoor coil. If the return air temperature is 70 deg at the unit, the coil discharge air temperature would be 100 deg. It is, therefore, easy to understand why the return air temperature should be maintained as high as possible. Uninsulated return ducts passing through a cold basement or crawl space will cause a drop in the temperature of the return air at the unit.

A coil discharge temperature of approximately 100 to 105 deg during winter operation is normal for most units. Constant operation of the fan will thus provide a satisfactory temperature selection range on the room thermostat.

The heat pump should be located away from areas where operating noise may bother occupants. Thus, a utility room between two bedrooms may not be an ideal location. Locating the unit adjacent to a wall directly facing another building where the discharge air noise, if any, is likely to disturb the occupants of the other building is not recommended. This is especially important where the air outlet faces a window of the neighboring structure. If the outlet must be located opposite a window, the discharge grille should have adjustable horizontal and vertical louvers so that the high velocity air stream may be directed away from the window. A better solution would be to duct the discharge away from the area.

Use flexible asbestos connectors in supply, return, and outside air ducts to minimize the possibility of sound being transmitted from the unit into the duct system and into the space.

In selecting the location for the unit, consideration must be given to the easy disposal of the condensate from the indoor coil during the cooling cycle, and from the outdoor coil during the defrost cycle.

If the unit is to be located on the first floor over a basement, condensate removal should not be too troublesome as the condensate pipe may be run through the floor to the nearest basement drain. Condensate removal from units mounted on concrete slab floor is likely to be much more difficult, especially when it is necessary to locate the unit some distance away from kitchen, bath, or other spaces equipped with drainage facilities.

Do not release condensate water to the ground directly beneath any floor. This may lead to excessive moisture

conditions beneath the floor and may result in high humidity conditions or floor deterioration. The condensate pipe may be taken directly through a side wall and drained to the ground outside the foundation if precaution is taken to guard against freezing of the defrost water drainage during winter operation. Freezing may occur in cold weather when the defrost water is drained from an open pipe on the outside of the building. Water may then back up into the outdoor coil drain pan and overflow into the unit and into the floor of the space. Defrost and condensate water drainage should be made inside the building, wherever possible.

Where interior space is not available, most heat pumps may be installed in a shelter outside the space. The shelter should protect the unit from the weather and all ducts to and from the unit must be insulated adequately. When located outside the building, Fig. 14, the heat pump should be mounted on a separate concrete base, where practical, to reduce the amount of noise transmitted to the floor of the conditioned area. Because most packaged heat pumps have only about one inch of interior insulation, their installation is not recommended in locations where the ambient temperature is likely to exceed 100 deg in summer and to fall below 35 deg in winter.

### Ducts, Supply and Return

Supply and return ducts for heat pump application differ only slightly from those used in conventional air conditioning systems. All ducts should be tightly sealed and insulated. Insulated ducts through unconditioned spaces minimize heat transfer from and to those spaces and prevent both internal and external duct sweating in unconditioned areas. One to two inches of good insulation is recommended.

An air velocity range of 800-1000 fpm should be maintained in main supply ducts, 600-700 fpm in branches, 500-600 fpm in risers, and 400-500 fpm at register faces.

Air velocity in return mains should be 600-800 fpm; branch returns 500-700 fpm; branch risers 300-500 fpm.

Duct runs under concrete slab floors or under ground must be well insulated and waterproofed.

Duct design for summer and winter operation is normally based on the nominal cfm air volume of the unit fan. If during heat gain or heat loss estimating, it is found necessary to increase the fan cfm, the ducts should be sized accordingly.

Ducts run in concrete slab floors, such as in perimeter duct systems,[1] need not be insulated but the edge of the floor should be insulated. See Fig. 15.

Other air ducts for heat pump application may be sized by conventional standards and methods following ASHAE design specifications. Duct runs should be kept as short and as direct as possible to minimize duct pressure loss and reduce installation costs.

The ventilation air inlet duct must be properly insulated and two inches of good insulating material are recommended. This duct must be provided with an adjustable volume control and the inlet should be covered with $\frac{3}{8}$ or $\frac{1}{2}$ inch mesh wire screen.

Outside air supply is introduced into the indoor return air duct at the heat pump and is of principal use during the cooling cycle. During the heating cycle, the volume of ventilation air should be considerably reduced if not entirely shut off. Infiltration will generally satisfy this ventilation need during the heating season and any appreciable amount of cold outdoor air introduced into the return circuit may (1) noticeably effect the heating capacity of the unit and (2) lengthen the time required to defrost the unit. The intake end of the fresh air duct should be open to the outdoors and should never be attached to the inlet duct of the heat pump outdoor coil. To do so may result in the outdoor fan robbing the indoor return air circuit since the outdoor fan usually handles a much greater quantity of air.

[1]Perimeter duct design may follow the standards described in Manual No. 11 of the National Warm Air Heating and Air Conditioning Association.

### Heat Gain and Heat Loss Estimates

Summer and winter load calculations for heat pump application are similar to estimates for conventional cooling and heating. It must be understood that certain rule-of-thumb methods, used extensively by warm air heating contractors, cannot be used in load estimating and selection of equipment for any type of heat pump application. The heating load and the heating capacity of the unit are normally so closely balanced that maximum output of the heat pump allows very little, if any, margin of oversize or extra capacity.

All custom-built heat pumps require supplemental heaters (sometimes called "booster heaters") for winter operation in certain sections of the country, depending upon whether or not the capacity of the unit matches the heat loss of the house at outdoor design temperature.

Supplemental heaters usually consist of one or more electric resistance heaters installed within the unit or in the supply duct or plenum. Some manufacturers install supplemental heaters as integral parts of the unit while others provide the heaters as accessory items.

For most economical operation, no more than 8 kw (27,304 Btu) of supplemental heaters should be applied to a 3 hp heat pump, and no more than 10 kw (34,130 Btu) to a 5 hp unit. Many application engineers believe that the capacity of installed supplemental heaters kilowatts should never exceed the total kilowatt input to the compressor and fan motors at outdoor design temperature.

Since most heat pumps, operating on the cooling cycle, are very similar to conventional air conditioners and have comparable cooling capacity, it is only necessary to determine, by conventional methods, the required capacity and then to select a unit capable of providing that capacity. It is often necessary to select a unit having excess cooling capacity in order to provide sufficient heating capacity, including supplemental heating.

### Determination of Supplemental Heating

The heating capacity of the heat pump and the heat loss of the house determines supplemental heater requirements. Performance data tables show the heating capacity of the unit at various outdoor temperatures down to 0 deg or lower. It is wise to note that the available output of an air-to-air heat pump decreases as the temperature of the outdoor air decreases. Also, the coefficient of performance decreases slightly as outdoor air temperature declines.

Performance data tables may or may not include recommended quantities of supplemental heating. This should be determined when using the tables, and manufacturers' recommendations closely followed. When the tables do not

include supplemental heat, the required kw of heaters, if any, may be determined by comparing house heat loss and heat pump capacity at outdoor design temperature. If house heat loss is less than unit capacity, no heaters are necessary. If it is greater than unit capacity, subtract unit capacity from the heat loss and divided by 3,413 (Btu in 1 kw). The result is the number of kw of supplemental heating required to maintain design indoor temperature when outdoor temperature drops to design conditions.

*Example No. 1*

Design outdoor temperature, 10 deg
Design indoor temperature, 70 deg
Heat loss of structure, 32,890 Btuh
Heat pump capacity at 10 deg, 36,000 Btuh
36,000—32,890 = 3,110 Btuh excess heat pump capacity.
No supplemental heating is, therefore, necessary.

*Example No. 2*

Same design temperature as in Example No. 1
Heat loss of structure, 58,000 Btuh
Capacity of heat pump at 10 deg, 36,000 Btuh
58,000—36,000 = 22,000 Btuh deficiency in capacity of heat pump.
22,000/3,413 = 6.44 kw supplemental heating required.

In Example No. 2, the 6.44 kw of required supplemental heating should be rounded off to the next multiple size of available heaters. Since most heaters are available in 1 or 2 kw sizes, 7 or 8 kw would be used.

The supplemental heating Btu requirements are always calculated at the outdoor design temperature to assure sufficient total capacity if and when outdoor temperature drops to that point.

## Balance Points

When the supplemental heater requirements are known, the next step is to determine when the elements will be energized. Knowing that a certain number of kw are required at design temperature, does not necessarily mean that all the heaters will be energized at that temperature.

For any particular structure total heat loss, there is a point on the heat pump capacity curve where heat loss and unit capacity are exactly equal. This point may be above or below the outdoor design temperature, but usually lies above. When below, no supplemental heating is necessary. This point of equality is known as the "first balance point."

Manufacturers provide charts on which capacity is plotted against heat loss over a temperature scale beginning at the lowest outdoor temperature recommended for the unit and extending upward through standard indoor design temperature. Such a chart is shown in Fig. 16. Example 2 was worked out on this chart.

Capacity curves are shown for a 3 hp and a 5 hp heat pump. To plot the heat loss against these curves, enter the chart at 10 deg (outside design temperature) on the temperature scale, follow the 10 deg vertical line until a point is reached corresponding to 58,000 Btuh (58 MBtuh) as read from the scale to the extreme left. Make a point at the intersection of the 10 deg vertical line and the 58,000 Btuh horizontal line. Then, with a straight edge, draw a line diagonally downward to the 70 deg point on the temperature scale. Where the capacity curve and this line intersect is the point where capacity and house heat loss are exactly equal. This is the first balance point.

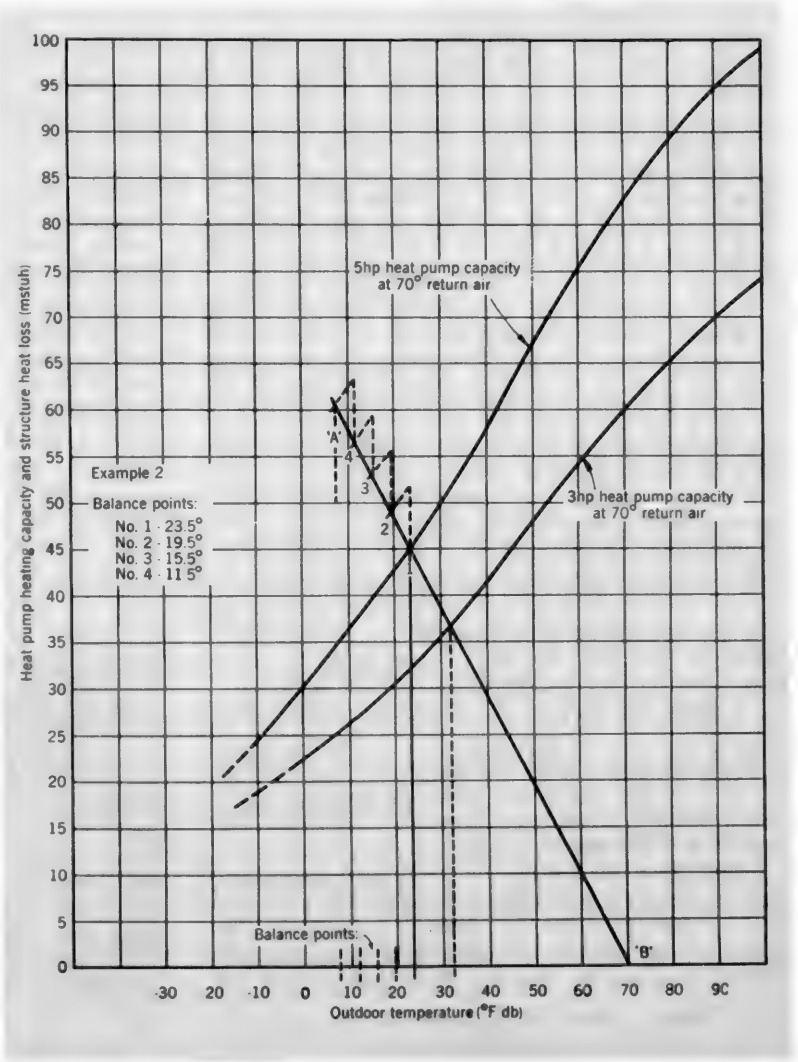



Fig. 16. Capacity curves of 3- and 5-hp heat pumps. Chart illustrates method of determining balance points when supplemental heating is required.

The outdoor temperature at which this balance occurs on the 5 hp capacity curve is 23.5 deg. Balance occurs at 32.5 deg on the 3 hp curve.

The first balance point on either curve indicates that the unit will heat the house to 70 deg until outdoor temperature drops to these conditions. When outdoor temperature drops below these points, supplemental heating will be required to maintain 70 deg within the space.

In Example 2, the 5 hp unit would require 7 or 8 kw of supplemental heaters, and the 3 hp unit would require 9.4 or 10 kw. The most economical installation, from a supplemental heater operating standpoint, would be the 5 hp unit. However, the cooling load often determines the size of the heat pump. If the cooling load in Example 2 is about 3 tons, and summer comfort is an important factor, it may be better to use the 3 hp unit even though the booster or supplemental heater requirements are high. The 5 hp unit would have 2 tons excess capacity which may cause a cool but clammy and uncomfortable summer condition.*

Heat pump selection involves a careful consideration of structure heat gain and loss versus unit capacity (approach to critical unbalance), cost of unit, available space, economy of operation, required or acceptable summer comfort conditions, etc. It is often difficult to select a unit "over-size" for heating, as is often the practice in selecting fuel burning heating equipment, and still come up with a unit, which is ideally suited to the cooling requirements.

Assuming that the 5 hp unit in Example 2 and Fig. 16 is to be installed with 8 kw of supplemental heaters, the outdoor temperature at which the heaters must be energized must also be determined. They may all be energized at one time, or in steps of one heater per step. The choice of methods depends to a great extent upon the cost of electricity.

The first method is often employed in areas where electric rates are based on a meter reading of the actual kwh consumed. The outdoor thermostat is set to energize the total increment of supplemental heaters at 3 to 5 deg above the first balance point. The thermostat is set high to compensate for high winds and excessive infiltration. This method has the disadvantage of supplying more heat than is required at the first balance point and a decreasing excess down the outdoor temperature scale until the final balance point is reached at design outdoor temperature.

The second method is the most popular of the two and is widely employed throughout the trade regardless of the methods used by local power companies to establish charge rates. The first and succeeding balance points are determined and a 1 or 2 kw supplemental heater is energized at, or slightly above, the corresponding outdoor temperature.

The method of determining balance points beyond the first is shown in Fig. 16. It was assumed that 2 kw heaters were to be used. One kilowatt is equal to 3,413 Btu; 2 kw is equal to 6,826 Btu.

Beginning at the balance point of the 5 hp unit capacity curve, rise vertically up the 23.5 deg line for a distance equal to 6,826 Btu. Make a point here. Now draw a line parallel to the capacity curve from this point until it intersects the diagonal line between *A* and *B*. Note the outdoor temperature at the point of intersection is 19.5 deg. This is the second balance point. Repeat the 6,826 Btu vertical line from this point upward and again draw the parallel line. Do this as often as necessary until point *A* is reached or exceeded. Point *A* always represents the heat loss of the space to be heated.

Example 2 required four balance points, representing outdoor temperatures of 23.5, 19.5, 15.5 and 11.5 deg, to reach or exceed point *A*. Actually, the fourth 2 kw heater will provide sufficient capacity to maintain 70 deg indoor design temperature down to an outdoor temperature of 7 deg. Note that the fourth heater provided capacity which exceeded the requirements at 10 deg. The outdoor thermostats should be set one or two degrees higher than the balance points to prevent temperature lag within the heated structure.

If 1 kw heater had been used, and energized separately, there would have been 8 balance points and 8 outdoor thermostats, which is expensive and cumbersome. The 1 kw heaters could have been connected two per thermostat, in parallel, which would have decreased the points and thermostats to four.

Local electric utility company engineers should be consulted to determine the best and most economical method of installing and controlling supplemental heaters with respect to the unit cost of electricity.

### Power Wiring

The local electric utility should also be consulted to determine suitability of the electric service to the building receiving the heat pump installation. This is especially important in residential applications because, in some instances, the area feeder service was not engineered and designed to handle multiple installations of integral horsepower motors. The lines are soon overloaded resulting in light dimming, low voltage conditions and difficulty in motor starting.

Most residential installations will be single phase units because there are very few residential neighborhoods to which three-phase service has been provided. Installation of central plant residential air conditioners has not, up to this time, been heavy enough in most residential neighborhoods to merit the additional expense to the power companies for the construction of three-phase distribution systems. For instance, an entire residential feeder circuit may serve no more than ten 3 hp central plant air conditioners. The cost of the distribution system would be approximately the same for a connected load of 30 hp as

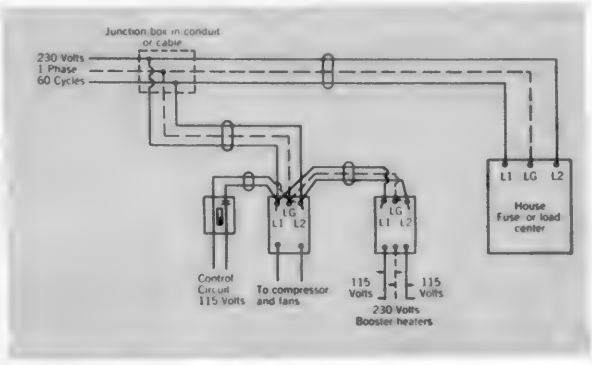



Fig. 17. Basic power circuit for an air-to-air heat pump. Booster heaters may be operated on one or both 115 volt legs.

*See HEATING AND VENTILATING, June, 1954, Year-Round Air Conditioning, by W. Yeary; also, HEATING AND VENTILATING, August, 1953, Problems in Residential Air Conditioning, by W. Yeary.

it would be for 3000 hp. Many years would be required to return to the utility the construction cost alone, to say nothing of the cost of maintenance and power generation. Three-phase service for most residential areas just is not feasible or justifiable on the strength of present or anticipated load potential.

The National Electrical Code and all applicable local electric codes should be consulted and all work done accordingly. For instance, some electric utility companies prohibit or discourage the installation of single phase motors larger than 3 hp on residential circuits. Some local electric power boards or commissioners insist that integral motor branch circuits must be run in pipe conduit only while others agree to certain types of cable.

The heat pump circuit should not be connected into the electric service on the fused side of the household supply. If a separate meter is not installed for the heat pump, its power supply should be taken from the "hot" side of the first disconnect or fuse center and a separate fused disconnect installed. No other appliances should be fed from the fused side of the heat pump power main disconnect.

Wire sizes should be determined from the tables in the National Electrical Code or from the wiring diagrams and information given in the manufacturers application, performance and specification data. Under no circumstance should wire be sized less than that recommended in either of these sources.

Manufacturers provide wiring diagrams which simplify the connections to be made during installation. Most packaged heat pumps are shipped from the factory with all internal wiring completed and the only local wiring necessary is branch circuit and control wiring. A typical branch circuit wiring diagram is shown in Fig. 17.

## Control

Heat pumps may be provided with two individual thermostats to control the cooling and heating cycles, or they may have one combination type thermostat to perform both functions. The combination type thermostat usually has one step or stage of cooling and two stages of heating. The first stage operates the heat pump alone, without supplemental heaters, and the second stage simply energizes the supplemental heater circuit.

Heat pump control is usually very simple and requires no additional control instruments not used on conventional air conditioners.

## Heat Pump Room Thermostats

The accessory room thermostat used with most heat pumps has two steps (two sets of contacts) for heating and one step for cooling. The first heating contact energizes the compressor motor starter magnetic coil which closes the starter contacts and starts the compressor. As long as the heat pump alone is able to keep the room thermostat satisfied, it will continue to operate on this first contact. If the outdoor temperature drops to or below the first balance point (where heat pump capacity and house heat loss are equal) and heat pump capacity begins to decrease with increasing house heat loss due to continued drop in outdoor temperature, the heat pump alone will not be able to maintain design indoor temperature.

As the indoor temperature drops, the second set of contacts start to close. If indoor temperature drops as much as two degrees, the contacts will close and energize the supplemental heater circuit relay. All outdoor thermostats and related supplemental heaters are connected into the relay circuit. When the relay functions, the heaters and thermostats are placed on a standby basis and the first heater will be energized provided its outdoor thermostat has been properly adjusted for the outdoor temperature corresponding to the first balance point. The other heaters, if any, will be energized only if outdoor temperature continues to drop to the temperature corresponding to each successive balance point to which the outdoor thermostats have been adjusted.

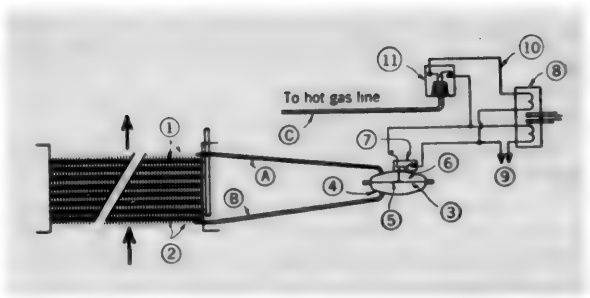



Fig. 18. Defrost cycle mechanism for heat pump.

## Defrost Cycle

When outside temperature is in the vicinity of freezing, and there is moisture in the air, there is a tendency for the outdoor coil to collect frost. This is a normal occurrence, as the coil is serving as the evaporator or cooling coil in this phase of the cycle. Should the frost build up to a point where it interferes with the proper operation of the unit by decreasing the circulation of outside air through the coil, the heat pump automatically changes to the defrost cycle and clears the frost from the coil. A drain is provided for removal of the water resulting from melting the frost from the coil.

The automatic defrost cycle lasts about 6 minutes and has no noticeable effect on the operation of the system except that the indoor temperature may drop one or two degrees during the cycle. The reason for this drop is that the unit reverses its cycle from winter to summer operation and the indoor coil becomes the evaporator or cooling coil as in summer operation.

To prevent this temperature drop, the installed complement of supplemental heaters should be energized when the unit goes into the defrost cycle so that heat will be supplied to the conditioned space.

The total number of defrost cycles occurring in any one locality depends upon the average winter temperature and the amount of moisture in the outdoor air. If the defrost switch is properly adjusted on the job and sufficient supplemental heaters are energized during the cycle to prevent cooling of the space, minimum discomfort should be experienced during the defrost cycle.

## Sequence of Defrost Cycle Operation

The mechanism of a typical defrost control circuit is shown in Fig. 18. The operation of this particular circuit is as follows:

Frost accumulates on the leaving air side (1) of the outdoor coil.

Air pressure increases on the entering air side (2) of the outdoor coil and in pressure tube *B* as a result of the

condition of partial blocking of the coil by (1). Pressure on the leaving air side (1) and in tube *A* remains constant.

Air pressure in *B* enters side (3) of diaphragm valve (4) and exerts pressure against diaphragm (5).

No change in pressure occurs on side (6) of diaphragm valve (4) because of constant pressure in tube *A*.

Therefore, diaphragm (5) moves toward side (6) pushing the plunger of microswitch (7) into the switch and closing the contacts. (Contacts of microswitch (7) are normally open.)

When microswitch (7) contacts close, relay (8) is energized by electric power being applied at (9).

Relay (8) contacts close, reversing the four-way valve in the refrigerant circuit, stopping the outdoor fan, and providing a series holding circuit (10) for the relay. When the fan stops, and no pressure is being exerted through tube *B* against the diaphragm of valve (4), the holding circuit is necessary to hold in relay (8) so that the unit will continue in the defrost cycle.

Therefore, when the fan stops, diaphragm (5) returns to its normal position and opens the contacts of microswitch (7). At this point holding circuit (10), which is already made between relay (8) and pressure switch (11), takes over and holds in the relay, preventing operation of the fan and holding the four-way valve in the defrost (or cooling) position.

When the coil is free of frost and the hot gas pressure in the coil increases to approximately 110 psi for F-12, and 190 psi for F-22, switch (11) will open since this pressure is applied to the bellows of the switch through tube *C*. This breaks the series holding circuit, allowing the relay to drop out and return the unit to its normal heating cycle.

When relay (8) is de-energized, the four-way valve returns to the heating cycle position and the outdoor fan starts to run. Thus the defrost cycle is completed.

## Mild Weather Control (Air-to-Air Systems)

Some heat may be required within a structure even when outdoor temperature rises to 60 or 70 deg. At the higher outdoor temperatures, the COP of the heat pump is greater because more heat is available at the outdoor coil. The heat loss of the structure is much less because of the smaller differential between indoor and outdoor temperatures. This combination of conditions may cause the compressor to cut out on high head pressure because more heat is being delivered to the outdoor coil by the outdoor fan than the compressor can handle, or more than can be transferred to the conditioned space from the indoor coil.

To prevent this condition an automatic control must be provided which will cycle the outdoor fan according to condensing pressure and/or temperature. Such a control is commonly called a mild weather control or switch. The control will stop the outdoor fan when condensing pressure and temperature rise to a predetermined high limit setting and will start the fan when pressure and temperature drop to a low limit setting.

At the higher outdoor temperatures intermittent operation of the fan is essential to prevent the transfer of excess heat into the outdoor coil and consequent overloading of the system beyond its ability to dissipate the heat into the conditioned space.

## Operating Cost

A method of estimating power consumption of the heat pump now appears to be a more important selling feature than a convincing argument that the heat pump will actually perform as advertised.

Any operating cost analysis furnished the customer should be labeled Approximate Estimate. It is impractical to arrive at an exact and accurate estimate of the cost of operation in any one area. A number of variable factors enter into the estimate which can, and do, cause operating costs to vary considerably.

The operating cost analysis is composed of mathematical calculations based on certain known and assumed quantities. The assumed quantities are those which create possible inaccuracies in the estimate and, unfortunately, there is very little we can do about it. For instance, for heating we can only estimate operating cost on an assumed number of degree days, number of hours of operation, and use or occupancy of the space. Nature and the elements control all three of these factors.

There is no guarantee that the same number of degree days which occurred last winter will occur this winter. If the number is greater, and well it may be, the number of hours of operation will increase and operating cost will rise accordingly. When use and occupancy of the space appreciably increase, or if occupants are dissatisfied with the original design indoor temperature and demand a higher one, more heat may be required. Again, an increase in operating cost will occur.

These "increase" factors apply not only to the heat pump, but to any other type of heating apparatus. They are discussed here to show the importance of making only average or approximate operating cost estimates for your customer.

## Other Heat Sources

Many times advantage may be taken of other heat sources within a commercial structure to reduce the total heat pump capacity requirements. These are often in the form of lights, motors, ovens, appliances, etc. The effect of household appliances is negligible in residential applications and should not be considered. Additional heat in commercial establishments should be considered and subtracted from the total heat loss. Care must be exercised to insure that such auxiliary heat is not considered unless it adds to the total heat throughout the entire business day.

## Primary Factors in Operating Costs

Power consumption is the primary factor in estimating operating costs, with the cost of electricity following closely as a mathematical multiplier.

Most electric utility rates for heavy duty service contain a demand clause. This demand is based on the type of rate and service, and the demand of the attached electrical apparatus. The electric utility is usually willing to assist in figuring demand rates and the reduction of such rates to an equivalent cost per kwh.

The actual monthly demand of the heat pump, plus any supplemental heaters, will vary according to weather conditions and usage. This is why an accurate operating cost estimate is difficult to calculate.

## Degree Days

It is extremely difficult to calculate heat pump operating cost for heating on a monthly basis. Consequently,

the seasonal or yearly degree day method† is commonly used and the estimated total cost averaged over the heating season or the year. Common practice is to estimate both cooling and heating costs and then divide the total by 12 for a monthly average cost. In areas where neither cooling nor heating is required during some months, the total estimated cost may be divided by the number of months of actual operation.

Degree-days for various cities may be found in Table 1. (Additional cities are given in the Reference Section, Air Conditioning, Heating and Ventilating, March, 1954.)

†See The Degree Day, by C. Strock, AIR CONDITIONING, HEATING AND VENTILATING, March, 1954, and March, 1956.

Both of these sources show degree days on record as of 1954 or later and may be used without reservation in the following method of calculating heat pump operating cost. For those not familiar with the degree-day, the writer recommends the Reference Section, Air Conditioning, Heating and Ventilating for March, 1956. Reprints of this section are available by writing directly to this publication.

## Heating Cost Calculations

The simplest method of calculating heat pump operating cost for heating involves the determination of *total seasonal Btu requirements* and then reducing this figure

**TABLE 1.—DATA FOR ESTIMATING COSTS**

| City | No. of Degree-Days in Normal Heating Season | No. of Hours Intermittent Heating Plant Operates in Normal Year | Outside Winter Design Temp., Deg. | Equivalent Full Load Hours of Operation for Residential Cooling per Year | K, Heat Required, Btu per Degree-Day | Average Temperature During Normal Heating Season, Deg. | Number of Days in Normal Heating Season |
|---|---|---|---|---|---|---|---|
| Albany, N. Y. .... | 6319 | 2232 | −10 | 200 | 360.6 | 40.3 | 256 |
| Albuquerque, N. M. | 4389 | 1625 | 0 | 625 | 429.3 | 45.2 | 222 |
| Atlanta, Ga. ..... | 2811 | 1863 | 10 | 750 | 538.0 | 50.5 | 194 |
| Baltimore, Md. ... | 4203 | 1548 | 0 | 700 | 440.0 | 48.1 | 248 |
| Boise, Idaho ..... | 5890 | 1888 | −10 | 550 | 370.5 | 43.7 | 277 |
| Boston, Mass. .... | 5791 | 2138 | 0 | 200 | 420.3 | 42.9 | 262 |
| Buffalo, N. Y. .... | 6838 | 2339 | −5 | 150 | 383.6 | 40.0 | 273 |
| Chicago, Ill. ..... | 6310 | 2018 | −10 | 400 | 359.8 | 39.9 | 251 |
| Cincinnati, Ohio .. | 4532 | 1670 | 0 | 850 | 427.1 | 44.7 | 223 |
| Cleveland, Ohio ... | 5717 | 2116 | 0 | 450 | 417.3 | 42.0 | 249 |
| Columbus, Ohio ... | 5615 | 1691 | −10 | 650 | 365.4 | 42.1 | 245 |
| Dallas, Tex. ..... | 2272 | 836 | 0 | 1425 | 465.0 | 51.0 | 162 |
| Denver, Colo. .... | 5673 | 1653 | −20 | 350 | 329.1 | 43.7 | 266 |
| Detroit, Mich. .... | 6404 | 2045 | −10 | 450 | 360.6 | 40.3 | 259 |
| Duluth, Minn. .... | 9474 | 2526 | −25 | 200 | 295.2 | 35.3 | 319 |
| El Paso, Tex. ..... | 2641 | 1151 | 10 | 955 | 538.4 | 50.6 | 183 |
| Fort Wayne, Ind. .. | 6287 | 2013 | −10 | 650 | 360.9 | 40.3 | 255 |
| Fresno, Calif. ..... | 2532 | 1521 | 25 | 920 | 735.5 | 51.8 | 192 |
| Grand Rapids, Mich. | 6474 | 2072 | −10 | 500 | 360.3 | 40.1 | 260 |
| Houston, Tex. .... | 1276 | 676 | 20 | 1450 | 739.2 | 55.8 | 138 |
| Indianapolis, Ind... | 5134 | 1643 | −5 | 800 | 366.9 | 42.6 | 229 |
| Jackson, Miss. .... | 2202 | 1058 | 15 | 1150 | 609.6 | 52.4 | 175 |
| Jacksonville, Fla... | 1113 | 665 | 25 | 1615 | 849.5 | 56.6 | 132 |
| Kansas City, Mo. .. | 4888 | 1563 | −10 | 900 | 365.5 | 42.8 | 220 |
| Little Rock, Ark. .. | 2982 | 1189 | 5 | 1200 | 484.9 | 49.1 | 187 |
| Memphis, Tenn. ... | 3006 | 1112 | 0 | 1050 | 449.0 | 48.8 | 186 |
| Miami, Fla. ..... | 173 | .... | 35 | 1730 | .... | 63.3 | 100 |
| Milwaukee, Wis. .. | 6944 | 2081 | −15 | 350 | 337.7 | 39.4 | 271 |
| Mobile, Ala. ..... | 1529 | 732 | 15 | 1310 | 651.9 | 54.9 | 151 |
| New Orleans, La... | 1175 | 625 | 20 | 1500 | 755.6 | 56.3 | 135 |
| New York, N. Y. .. | 5050 | 1868 | 0 | 350 | 424.7 | 44.0 | 241 |
| Omaha, Neb. .... | 6160 | 1973 | −10 | 800 | 357.9 | 39.2 | 239 |
| Phoenix, Ariz. .... | 1492 | 894 | 25 | 1300 | 799.5 | 55.0 | 149 |
| Pittsburgh, Pa. ... | 5048 | 1865 | 0 | 400 | 422.0 | 43.4 | 234 |
| Raleigh, N. C. .... | 3075 | 1338 | 10 | 1050 | 531.2 | 49.8 | 202 |
| Reno, Nev. ..... | 6036 | 2067 | −5 | 500 | 398.3 | 44.6 | 296 |
| Salt Lake City, Utah | 5463 | 1748 | −10 | 600 | 369.0 | 43.3 | 252 |
| San Antonio, Tex... | 1579 | 842 | 20 | 1300 | 700.4 | 54.1 | 145 |
| Shreveport, La. ... | 2117 | 1131 | 20 | 1460 | 710.0 | 52.0 | 163 |
| St. Louis, Mo. .... | 4469 | 1651 | 0 | 1000 | 425.6 | 44.2 | 215 |
| St. Paul, Minn. ... | 7804 | 2205 | −20 | 350 | 311.7 | 35.4 | 264 |
| Tulsa, Okla. ..... | 3584 | 1324 | 0 | 1050 | 436.1 | 46.6 | 195 |
| Washington, D. C.. | 4910 | 1573 | 0 | 800 | 424.9 | 44.1 | 235 |
| Wichita, Kan. .... | 4571 | 1463 | −10 | 900 | 372.3 | 44.2 | 220 |

to the total number of fuel units required by dividing total seasonal Btu requirements by the Btu value of *one* fuel unit. Once the total number of fuel units, and the efficiency of the fuel unit, are known it is a simple matter to determine seasonal heating costs.

The fuel unit (kwh) efficiency for electrical heat pump operation is known as the Coefficient of Performance or C.O.P. of the pump. The C.O.P. must be known before reliable operating costs can be determined. Therefore, total seasonal Btu requirements for heat pump operation must be reduced to kilowatt-hours (kwh) electrical input by proper application of the Btu value of one kwh times the C.O.P.

The *average* winter temperature is normally used in determining heat pump C.O.P. because it is anticipated that the pump will operate most of the time at that temperature. By use of heat pump performance data the capacity of the unit at the local average winter temperature is first determined. Then the C.O.P. may be found by dividing the capacity of the pump at the given outdoor average temperature by the kilowatt input at that temperature times 3,413 (Btu value of one kw).

Thus:

The average winter temperature of El Paso, Texas is 50.6 deg. Assume that the capacity of a 5 hp heat pump at 50.6 deg outdoor temperature and 70 deg indoor temperature is 70,000 Btuh, and the input is 6.5 kw.

Therefore:

$$\text{C.O.P.} = \frac{70{,}000}{6.5 \times 3.413} = \frac{70{,}000}{22{,}185} = 3.2 \quad (1)$$

This means that the available capacity ratio of the heat pump is 3.2:1, or, that it will deliver 3.2 times the electrical energy input to the unit.

The equation

$$H = \frac{25(5d + D)h}{(t_i - t_o)} \quad (2)$$

where

- $H$ = seasonal heat loss in Btu,
- $h$ = hourly heat loss from the building for the design conditions, Btu,
- $t_i$ = inside temperature, deg,
- $t_o$ = outside design temperature, deg,
- 24 = hours per day,
- $d$ = number of days in the heating season.

may be used to determine the total seasonal Btu requirements to heat a specified space or building. This equation applies equally to gas, oil, or electrical energy.

Equation (2) has been further simplified by reducing a portion of it to a *K* factor* which can be explained as the heat unit requirement for a particular locality, in Btu per degree-day per 1000 Btu per hour heat loss at the design conditions. Thus, the working formula becomes

$$H = KD\frac{h}{1{,}000} \quad (3)$$

where

- $H$ = heat to be supplied, Btu per normal heating season, at 100% efficiency,
- $h/1000$ = heat loss in thousands of Btu per hour at design conditions,
- $D$ = normal number of degree days per year.
- $K$ = heat to be supplied, Btu per degree-day per 1,000 Btu per hour heat loss at design conditions, for the city in question. Note that *K* is a constant only for a given city or small area.

Values of *K* and *D* are given in Table 1, and in the March, 1956, Reference Section of Air Conditioning, Heating and Ventilating.

The following example, with factors based on El Paso conditions, will demonstrate the use of Formula (3):

1. Degree Days = 2,641 (Table 1)
2. K Factor = 538.4 (Table 1)
3. $t_o$ = 10 deg (Table 1)
4. $t_i$ = 70 deg (assumed)
5. Average outdoor winter temperature = 50.6 deg (Table 1)
6. C.O.P. of pump = 3.2 (see above)
7. h at 10 deg = 58,000 Btuh (house heat loss)
8. h at 50.6 deg = 19,000 Btuh
9. Kwh input at 50.6 deg = 6.5

Substituting in Formula (3):

$$H = 538.4 \times 2{,}641 \frac{58{,}000}{1{,}000} = 82{,}471{,}035$$

Then to reduce this figure to equivalent kwh:

$$\text{Equivalent Kwh} = \frac{82{,}471{,}035}{3.413} = 24{,}134 \text{ plus kwh.}$$

It would seem that by dividing 24,134 by 3.2, the C.O.P. of the pump, the actual kwh input requirements could be determined. First, however, the booster or supplemental heat kwh must be determined and *subtracted* from the equivalent kwh. The necessity for this is easily understood when we consider that the C.O.P. of 3.2 applies only to the heat pump without supplemental resistance heaters. The efficiency of straight resistance heaters is usually considered as being 1, which represents a coefficient of performance, or ratio of input to output, of 1 : 1.

The full kwh load of any supplemental resistance heaters must, therefore, be subtracted from the equivalent kwh requirements, the remainder is then divided by the heat pump C.O.P., and then the supplemental kwh is added to the resulting figure.

Assume that seven (7) kw of supplemental resistance heaters are required in the El Paso example and that the balance points are 24 deg, 20 deg, 16 deg, and 12 deg, as determined by the method previously illustrated. The number of hours of operation below the *first balance point,* and the required kw of resistance heating for each hour, must now be estimated. Due to the lack of reliable data on resistance heater operation this can only be an estimate at best. For this example, assume the total number of hours of heat pump operation to be 1151 per season. See Table 1 for El Paso, Texas.

Since the average winter temperature is 50.6 deg, and the first balance point is 24 deg, the heat pump will have excess capacity above 24 deg outdoor temperature. At that point heat pump capacity and heat loss of the structure will be equal. Further assume that the first 2-kw heater will operate approximately 1/10 of the total heat pump operating hours or 115 hours to maintain design

indoor temperature when outdoor temperature varies between 24 deg and 20 deg (second balance point). Also, that the second 2-kw heater will operate 7 percent, or 81 hours, of the total time when outdoor temperature varies between 20 and 16 deg, that the third 2-kw heater will operate 4 percent, or 46 hours, when the outdoor temperature is below 16 deg, and that the fourth will operate one (1) percent, or 12 hours, when outdoor temperature is below 12 deg.

This means that *one* heater will be in operation on the *first* supplemental heater phase, *two* on the *second*, *three* on the *third*, and *four* on the *fourth*.

Thus:

115 hours using 1 — 2-kw heater = 2 × 115 = 230 kwh
81 hours using 2 — 2-kw heaters = 4 × 81 = 324 kwh
46 hours using 3 — 2-kw heaters = 6 × 46 = 276 kwh
12 hours using 4 — 2-kw heaters = 8 × 12 = 96 kwh

Total Supplemental Heating Needed = 926 kwh

*Subtract* the 926 kwh of supplemental heat required from 24.134 kwh (equivalent kwh input): 24,134 — 926 = 23,208 kwh of heating supplied by the heat pump alone based on straight kw input before applying C.O.P. factor.

The C.O.P. of the heat pump was previously found to be 3.2 at specified design conditions and average winter temperature in the El Paso area. To determine the actual kwh input to the unit alone, divide 23,208 by 3.2 = 7,252.5 or 7253 kwh input to the heat pump.

### Defrost Cycle

We must also determine the kwh required during the defrost cycle and add this to the actual heat pump kwh as determined above.

The average defrost cycle takes about 6 minutes and a 5 hp unit will extract approximately 2150 Btu (a 3 hp unit about 1700 Btu) from the conditioned area. The rate of the area heat loss during the defrost cycle of a 5 hp unit would then be:

$$2,150 \times 60\ 6 = 21,500 \text{ Btuh}$$

This is equivalent to 6.3 kw (21,500/3,413) or that amount of supplemental heat needed to *just* counteract the cooling effect of the defrost cycle. This does not, however, include the normal heat loss of the conditioned area during the time the unit is defrosting. To determine this loss, the heat loss per degree F of the house must be known. In this example the house heat loss was 58,000 Btuh, and the difference between indoor and outdoor design conditions was 60 degrees. The following equation is applicable:

$$H_L/_{oF} \quad \frac{58,000}{70 - 10} = \frac{58,000}{60} = 967 \text{ Btu} \qquad (4)$$

Therefore, the normal heat loss of the structure during each six (6) minute period may now be calculated as follows:

$$H_L \text{ for 6 min. period} = \frac{967 \times (70 - 10)}{10} = 5,802 \text{ Btu}$$

(Note: The figure 10 below the line is determined by dividing 60 (minutes) by the length of the defrost cycle).

This additional 5.802 Btu is equivalent to 1.7 kw during the defrost cycle. Therefore, 6.3 kw plus 1.7 kw = 8 kw for defrost purposes.

Since supplemental heaters are usually supplied in 2-kw sizes the four 2-kw supplemental heaters (8 kw) would supply the capacity required for defrost purposes, but would probably not be absolutely necessary for satisfactory operation of the defrost cycle.

Assuming that the heat pump would defrost 100 times per heating season in the El Paso area, 100 × 6 = 600 minutes of defrost operation per year, or, 600/60 = 10 hours of defrost operation. Therefore, 10 × 8 = 80 kwh required per season for defrost operation.

### Totals, Heating

The total kwh input during the normal heating season would then be:

| | |
|---|---|
| Heat pump input | = 7,253 kwh |
| Supplemental heaters | = 926 kwh |
| Defrost requirements | = 80 kwh |
| Total kwh input, heating | = 8,259 kwh |

### Operating Cost, Heating

Operating cost depends upon demand rate, cost per kwh, etc., and these must be determined to estimate the seasonal cost for electricity.

Assuming a straight 2 cents per kwh rate, the cost of operating the example heat pump for heating would be:

8,259 × .02 = $165.18 per heating season.

Or:

at a 1.5 cent rate per kwh:

8,259 × .015 = $123.89 per heating season.

### Cooling Costs

Power consumption for cooling is equally difficult to estimate accurately because of variations in the factors involved. Estimates must be calculated on one particular set of conditions and if either of the elements of the conditions are changed, the operating cost will likewise change. It may increase or decrease, depending upon which element is varied and in what direction.

For instance, if operating costs are calculated on 80 deg indoor temperature and the unit is operated at 75 deg, costs will naturally increase. If the estimate is based on a given number of hours of operation, costs will vary according to any variation in this number of estimated hours.

The normal indoor design temperature for both residential and commercial operation is 80 deg. If any indoor temperature less than this is used, an increase in operating cost of approximately 8% per degree difference will occur in residential applications and approximately 3 per cent per degree difference in commercial applications.

### Commercial Cooling

The most accurate method of calculating total number of cooling hours for commercial applications is an estimate based on the experience of local contratcors and conditioner owners. First, determine the normal cooling season in your particular area and then the total number

of full load hours the proposed application is likely to be operated per business day. This is usually equal to the number of hours the establishment is open for business each day. Thus:

Cooling season: May 1 to September 30 = 5 months (length of season usually known by engineers and contractors in each area) or 22 weeks.

22 × 6 days per week = 132 days per season.
Store open 6 days per week, 10 hours per day.

132 days × 10 hours per day = 1320 hours per season (full load).

To use 1320 hours in the estimate assumes continuous or full load operation of the unit, which is seldom true. Therefore, an *equivalent* full load operating condition must be found. As a rule, a percentage of full load is assumed for these purposes and it may vary from area to area. The equivalent full load operating hours are generally known by contractors and engineers in each particular area.

Roughly, estimated percentages to be applied against full load operating hours to obtain equivalent full load operating hours are shown below for various sections of the country. These are presented as estimated percentages for guidance only.

| | | | |
|---|---|---|---|
| Southwest | 90% | West Coast | 75% |
| Mid-South | 85% | Mid Central | 87% |
| Southeast | 85% | North Central | 75% |
| Deep South | 87% | Northeast | 67% |
| East Central States | 80% | Northwest | 73% |

Assuming the area of the previous example is Southwestern, equivalent full load operating hours would be:

1320 × 0.90 = 1188 hours per season.

Therefore, if the heat pump input is 6.97 kw, total kwh input will be:

1188 × 6.97 = 8280 kwh per season.

Also, assuming cost of electricity to be 1.5¢ per kwh, seasonal operating cost will be approximately:

8280 × .015 = $124.20 per season.

This figure does not take into account the likelihood that the indoor temperature may be maintained at something less than 80 deg.

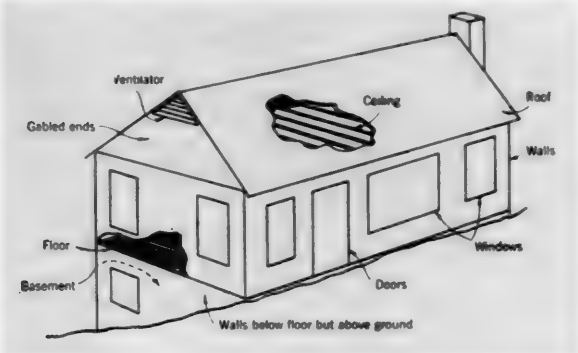



Fig. 19. Areas of a residence which contribute the greatest load in heat gain and heat loss.

## Residential Operating Cost

Residential operating hours are determined in a manner slightly different to that used in commercial estimates. The average residential air conditioner does not actually operate 24 hours per day although the load may have been calculated on that basis. Various test houses in different sections of the country show that the conditioner may run continuously for from 5 to 8 hours and then operate intermittently for a few hours before cutting off completely (or recycling a minimum number of times during the night) until the next day when the load again increases.

Thermal inertia must be recognized as a factor of importance in residential cooling. Its effect tends to keep a house cool, or warm, as the case may be. Advantage is gained in residential cooling simply because once the house is cool it tends to stay cool. Consequently, the load a unit hooks into in residential cooling is never as severe, after once pulling the temperature down, as is the load in a commercial establishment of the same square area.

The result of this is that the residential unit will normally not come on until about noon, will then operate continuously (providing selection is properly made) until 6 or 7 p.m., and then recycle for an hour or two before cutting off for the evening. It is easy to understand this when it is considered that a normally occupied and closed house exhibits very few of the internal load characteristics found in commercial jobs. Also that the house resists any attempt to change its internal temperature—once cooled, and it resists any external effort to warm up its interior.

Therefore, the full load operating hours of a residence are actually not 24. The use of 12 hours is quite sufficient and 6 to 10 is probably more correct, depending upon geographic location. Southwestern areas may require 12 hours while Mid-Central may require 8. East Central runs somewhere around 6 or 7 hours. A study of your particular area should provide the most reliable data in this respect.

Representative residential equivalent full load operating hours for cooling are shown for various cities in Table 1. These figures may be used directly in the cost estimate equations without applying a percentage factor.

## Cost Example, Residential

Normal cooling season: May 15 to October 1 = 138 days (7-day week).

Estimated operating hours per day (equivalent full load) = 6

138 × 6 = 828 hours per season.

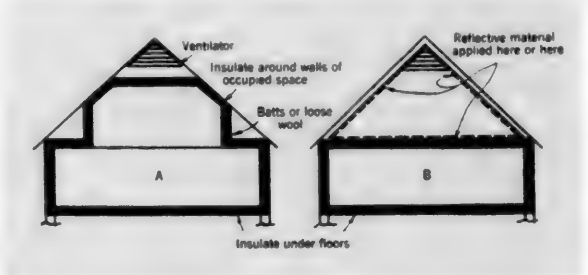



Fig. 20. Methods of applying insulation most effectively in walls and an (A, left) occupied attic and (B, rt.) an unoccupied attic.

Kw input of heat pump at 80 deg entering air = 6.97.

Kwh input = 828 × 6.97 = 5771 kwh.

Cost. at 1.5¢ per kwh = 5771 × 0.015 = $86.57 per season.

86.57/138 = 63¢ per day. (10.5¢ per hour.)

Monthly estimate = 30 (days) × 0.63 = $18.90 per month.

### Treatment of Critical Unbalance

The ideal heat pump installation is one in which the summer and winter requirements of the structure fall within the capacity range of the unit. The addition of 1 to 8 kw of supplemental heating might be called the near ideal application.

When the winter requirements begin to exceed the capacity of the unit plus a maximum of 8 kw supplemental heaters, a critical unbalance in the load is evident and measures must be taken to reduce the number of supplemental heaters. This means reducing the load against which the unit must operate.

A critically unbalanced condition may be one in which, for example, the summer requirements are 35,000 Btuh and 75,000 Btuh in winter at outdoor design conditions 0 deg or below. A 3 hp unit will provide sufficient cooling, but will be far short of the necessary heating capacity. It would require approximately 16 kw of supplemental heat, which is twice as much as recommended. A 5 hp unit will provide more than sufficient cooling capacity, but will be closer to the required heating capacity. The 5 hp unit may provide 30,000 Btuh at 0 deg outdoor temperature which means that the balance of 45,000 Btuh must be made up with supplemental heaters. This is equivalent to 13-plus kw or 6½ 2 kw supplemental strip heaters.

It is possible that a house in some of the more northern areas may have an unbalanced condition far more critical than this example. It is easy to understand that less cooling and more heating capacity may be necessary in northern Ohio or Michigan than would be required in a comparable house in Virginia or Kentucky. Critical unbalance is less likely to occur in the central and mid-southern states. However, the balance often reverses in the far southern areas and more cooling than heating may be necessary. Such a situation presents no problem and the use of supplemental heating is often not required. The heat pump is then selected according to the cooling requirements and the heating capacity of the unit alone, without booster heat, is sufficient in most cases.

Building construction specifications need not be drastically altered in every case in order to make use of a heat pump in critically unbalanced load applications. Modifications of specifications are, however, sometimes necessary to achieve a reasonably accurate balance between the seasons or, in other words, between the heating and cooling capacity of the unit.

When the unbalance becomes acutely critical in northern areas, the heat pump may provide sufficient cooling, if not too much, but may fall far short of the required heating capacity. It is also possible that the unit may provide more than sufficient cooling and will operate on short "on" cycles and long "off" cycles. This can create a serious situation in summer just as easily as a shortage of heating capacity can create a serious situation in winter.

### Booster Heaters

There are several ways to reduce the critical unbalance to one more suitable for the intsallation of the heat pump. It may be done with booster or supplemental heating or, in new construction, the building may be provided with additional insulation to reduce the heat loss. Summer cooling requirements are also going to be reduced by the addition of insulation, but not as rapidly as winter heating requirements (heat loss) are reduced. There are, in most cases, rooms which were not included in the original air conditioning calculation. Playrooms, utility rooms, work shops, basements, etc., are often entirely omitted from summer calculations because of the heavy load imposed upon the unit and because omission of these spaces will reduce the cooling requirements. These spaces may be returned to the calculations and included in the total summer load where additional insulation is added to reduce the winter capacity requirements.

Insulation of a home is a feature, which not only reduces the load for both summer and winter, but cuts operating costs, unit installation costs, and in many cases, the initial cost of the unit. Usable area is increased. the comfort zone is improved, and drafty conditions within the space are minimized. Insulation in walls, ceiling, and floors does increase the cost of the house, but the gain in comfort, reduction in first cost of the unit and lower operating costs will normally balance out the additional construction cost within a short period of time.

The heating capacity of the heat pump (any air-to-air heat pump) is related to the outdoor temperature, or, simply, the temperature of the outdoor air passing through the coil. As the temperature of the air passing through the outdoor coil (an evaporator in winter) rises or falls, so will the capacity of the heat pump rise and fall, that is, the heat pump without supplemental heaters.

A method which has been widely used to supply supplemental heating, over and above that recommended with the heat pump, is the inclusion of electric panel heaters in parts of the space. These may be installed in bedrooms, bathroom and the kitchen. Where they are actually installed is more or less a matter of choice, but the usual location is the bathroom, bedroom, or den. Control of the panels is important and they may be operated from an outdoor thermostat, indoor thermostat, or a toggle switch. Some installations make use of both a thermostat and a toggle switch so that additional heat may be had for short durations yet maintain automatic control of the temperature at some lower setting. Bathrooms are good examples for this type of control.

The five principal areas contributing most to the heat gain or loss of a structure, residential or commercial, are: 1 roof, 2 glass, 3 walls above floor level, 4 walls below floor level but above ground, and 5 the floor, as shown graphically in Fig. 19. The items of maximum transmission are not necessarily in order. That depends upon the amount of insulation, gross area, shading, and sun time.

### Heat Gain Locations

The roof of a building may account for the major portion of the heat gain or loss depending upon the amount of insulation, type of attic, type of roof and gross area. A ceiling and roof, with a 3-in. layer of insulation, having 300 sq ft of area will have a gain of 3,000 Btuh

assuming a temperature difference of 15 deg. The same roof, uninsulated, will transmit approximately 4,300 Btuh. In winter, with a 70 deg differential, this same roof insulated will have a heat loss of approximately 1,900 Btuh; uninsulated it will transmit approximately 7,300 Btuh.

There are two or three accepted methods of applying ceiling, attic or roof insulation for maximum effectiveness. If the attic is not used, the insulation should be laid between the ceiling joists. Appropriate ventilating louvers should be installed in the gabled ends of the house or at the eaves, but should be easily closed and sealed in winter. Where attic space is to be used, another method is to place the insulation around the walls of the usable space, as shown in Fig. 20.

Sun load of the roof may be reduced by the use of light colored roofing material. Marble chips are used extensively for this purpose in some areas of the country.

Ceilings above open porches and attached garages should be insulated to prevent cold floors, and consequent heavier heat gain or loss, in occupied spaces above.

Outside walls may be the major factor or contributor to heat gain and loss. The use of insulation to reduce the total gain or loss is recommended when a critical unbalance occurs. The type of insulation to be used should be chosen with care, especially in new construction or where the material is to be sealed within the wall. There is very little which can be done to improve a bad situation once the insulation is sealed inside the wall with a layer of brick on one side and a neatly plastered surface on the other. This situation will be encountered in many older homes and the only thing which can be done is to add insulation in the attic or roof, and to the underside of the floor. It is surprising how much reduction in load can be accomplished in this manner. The walls of existing frame houses or other buildings can be thoroughly insulated by blowing loose insulation into the stud spaces. Additional advantage may be gained in attics treated with insulation batts by applying reflective type insulation against the roof rafters or ceiling joists, as the case may be, and adding insulation to batts which are less than full thick. Ceiling beneath reflective insulation applied to roof rafters with 1 inch rigid type insulation will further reduce the gain.

Common walls between an attached, unheated garage and the house should be insulated as carefully as the outside walls of the house.

### Windows and Doors

Windows and doors are extremely important items to be considered in the total heat loss or gain estimate. Single glazed windows will conduct 3 to 12 times as much heat per square foot of glass area as will a square foot of wall area. Double glazing and storm windows will reduce transmission through the glass, and infiltration around the sash, by as much as 50%. The use of venetian blinds, or other types of window shading, are highly recommended to reduce heat gain.

Single glazed windows will transmit practically all the solar radiation striking the glass area in summer. Solar radiation is of little consequence in winter and does not even figure in winter calculations. Double glazed tinted glass is becoming quite popular for the reduction of solar radiation since it not only reduces this load, but minimizes sun glare inside the space.

Venetian blinds, draw drapes, pull shades, etc., are all used on the inside and cut transmission only as long as they cover the window. Awnings on the outside are better shading devices and eliminate direct sun rays against the glass area of the window. Roof overhang is very effective in reducing direct sun rays against windows.

### Floors

Cold floors are a nuisance. They make a house hard to heat in winter and are the source of much complaint from home owners. The same reasons that make them cold in winter also make them a heavy heat gain item in summer. Particular attention should be paid to proper insulation of floors over crawl spaces, open basements, etc.

Moisture beneath a floor can also present quite a problem in year-round air conditioning. Some type of vapor barrier should be installed beneath floors over crawl space and open basements, or in any application where there is moisture beneath the floors.

Uninsulated slab floors sometimes create a problem because of perimeter losses in winter. Such floors should have perimeter insulation installed during construction to prevent heat loss around the outside edges which results in cold surfaces.

### Basements

Basements below ground level seldom become a problem in cooling or heating unless there is some unusual internal load. The walls of the basement in contact with surrounding earth usually stand at about 50 to 60 deg surface temperature. In this respect, there is no heat gain in summer, and in winter it represents a temperature differential of only 10 to 20 deg instead of the normal differential between indoor and outdoor design conditions.

Basements present very little additional load in summer unless part of the area is used as a play room, work shop, or other living space. If this is encountered, calculate the load in the usual manner, taking into consideration the use of the space, number of people and degree of activity.

### Check List

Listed below are several suggestions as to how to reduce critical unbalance between heat pump capacity and house heat gain and loss. These items apply to both new and existing construction.

(1) Insulate or add insulation to ceiling, around walls of finished attic, or between roof rafters.

(2) Add reflective insulation to roof rafters, or tops of ceiling joists

(3) Close attic ventilators in winter. Use minimum 1 in. rigid insulation.

(4) Blow insulation into uninsulated frame walls.

(5) Insulate between floor joists.

(6) Weatherstrip all windows and doors.

(7) Double glaze windows. Use tinted glass where permissible.

(8) Install storm windows.

# Residual Heat for Initiating Emergency Power Generation

ARTHUR D. BENJAMIN

Senior Project Engineer, Voorhees Walker Smith and Smith, New York

**A great number of commercial and industrial buildings that are being constructed today are located in suburban areas. The expected increase in the frequency of power failures, due to the longer exposed runs of the electric utility service, makes the provision for emergency power generation almost mandatory. Here is an ingenious and economical method for starting up an emergency system.**

HERETOFORE the most common method used for the provision of emergency generation has been the Diesel generator set. This type of equipment requires no external source of power, the Diesel being the prime mover. A prime mover is necessary as the steam boiler in today's modern plant will be off the line on a power failure, thus negating the use of steam for emergency power generation. The most obvious disadvantages of a Diesel generator set, compared with a steam turbine, are high initial cost, difficulty of starting and the increased noise factor. The unfavorable price differential led to the investigation and design of a system utilizing a steam turbine working off the residual heat contained in the boiler water for the purpose of initiating the emergency power generation cycle.

A similar system to that, about to be described, has been designed for the Quaker Oats Company Research Laboratories at Barrington, Illinois. Following is a description of the design of a typical system utilizing residual heat in the boiler water for initiating emergency power generation.

## Electrical Sequence of Operation

Referring to the schematic diagram, Fig. 1, the following is the sequence of operation:

At time zero, the main breaker (1) will open, provided the fault is due to a service outage. The following simultaneous operations will then be effected.

(1) An alarm will sound and will continue to sound until manually silenced.

(2) The solenoids in the steam lines will be de-energized by the opening of the circuit breaker auxiliary contacts. This will cause solenoid valve S-1 in the main steam supply to close and S-2 in the turbo-generator steam line to open, permitting steam to operate the turbo-generator.

(3) All other circuit breakers on unit substation (2) will be opened by their time delay under voltage trip attachments and will remain so until closed by hand after normal power has been restored.

The generator voltage will now build up, causing the following control sequences:

(1) At 80% of rated voltage a relay will close, energizing an auxiliary relay, which in turn will close emergency circuit breaker (3).

(2) Emergency circuit breaker (3) will simultaneously energize emergency circuit breaker (4) which controls all

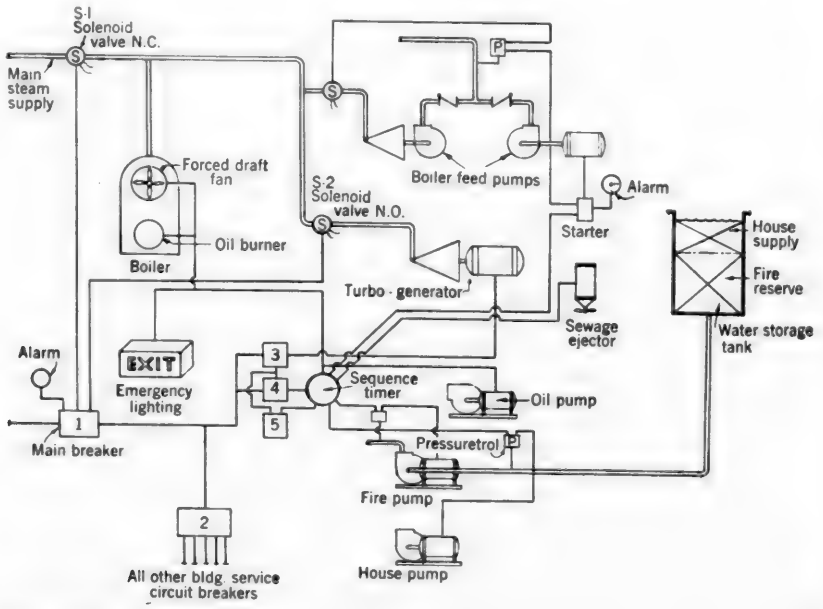



Fig. 1. Schematic diagram of system for using residual heat to initiate emergency power generation.

items connected to the sequence timer, and emergency circuit breaker (5) which controls the fire pump. Energizing of circuit breaker (5) will make the fire pump available as soon as all closing contacts on its starter have closed; this includes the sequencing timer contacts.

(3) As soon as emergency circuit breaker (4) has been energized, all loads connected to it will be made available for starting as the contacts on the sequence timer close and providing other controlled contacts in their respective starters are closed.

(4) Items energized initially are: (a) Forced draft fan; (b) oil burner controls; (c) emergency lighting; (d) oil pump.

(5) Ten seconds after the initial load is started the electric driven boiler feed pump will be made available for starting, providing the auxiliary contacts in its starter are closed.

The boiler feed pumps are piped into a common suction and discharge header. Under normal operation the steam driven pump is operative and the electric motor driven pump is the standby. Upon a failure of the steam driven pump, a pressure-stat located in the common discharge line and sensing feedwater supply pressure will, on a predetermined drop in pressure, simultaneously close a solenoid valve in the steam supply line to the turbine, start the electric driven pump through its auxiliary starter contacts (providing the sequence timer has completed its cycle) and energize an alarm.

The electric motor driven pump may be maintained in service by positioning a hand-off-automatic control to the "hand" position. The solenoid valve in the steam driven boiler feed pump steam supply line is automatically closed when the controller is so positioned.

(6) Five seconds after the boiler feed pumps are energized the house pump motor will be made available for starting if the pressure-stat in the fire pump inlet line indicates low house supply in the storage tank.

(7) Five seconds after the house pump has been energized the sewage ejector pump motors will be made available for starting and will start if the float switch contacts in the starting circuit are closed.

(8) Five seconds after the sewage ejector motors are energized the fire pump is made available for starting and will start if the low pressure contact in the fire standpipe line closes. At this point all loads supplied by the turbo-generator are connected to the emergency power circuit.

### Thermodynamic Sequence and Design

In the design of any system of emergency power the essential services requiring this power must be known. The example described is based on the use of a 150 kw generator. The following enumerates the connected load on a sample emergency cycle.

| *Equipment* | *Running Kw* |
|---|---|
| Boiler feed pump | 16.9 |
| House pump | 12.9 |
| Forced draft fan | 12.9 |
| Burner control and ignition | 0.5 |
| Emergency lighting | 7.5 |
| Fire pump | 61.5 |
| Sewage ejector | 6.6 |
| Fuel oil pump | 1.44 |
| Total connected load | 120.24 |

A turbo-generator will operate most efficiently when the inlet stream pressure matches the design working pressure. Since this cycle is dependent on using the minimum amount of steam this becomes an important factor in selection of the turbo-generator. The design pressure used should be approximately 40% of the boiler's operating pressure. Thus, if the boiler is to operate at 250 psig the turbine should be selected for 100 psig design. The use of this criterion will make the turbine somewhat larger, but it is a necessary condition in order to utilize most effectively the residual heat of the boiler water and to operate the turbine at its peak efficiency.

The foregoing calculations indicate the steps necessary to determine the final pressure existing in the boiler at the start of full emergency power generation. This parameter will be incorporated in an operating curve for the cycle. The characteristics of a steam turbine are such that a plot of available pressure against time results in a straight line when the turbo-generator is working with a constant load and the steam is available from a reservoir initially at a given pressure assuming no generation of additional steam.

The following equipment criteria will be used in the illustrative example:

(1) Boiler feed pump turbine steam rate .866 lb per sec.
(2) Turbo-generator steam consumption initially starting from rest with no load 5 lb per sec.
(3) 20,000 lb per hr water tube boiler; water capacity 11,000 lb.

To attain the necessary operating curve (Fig. 2) only two points are required. The calculations for these points are as follows:

Total heat available in boiler water, assuming that the turbine will be capacble of operation with a pressure reduction of up to 50% of design:

$h$ at 250 psig = 380 Btu per lb
$h$ at 50 psig = 267 Btu per lb
113 Btu per lb available

Total water content of boiler = 11,000 lb

$11{,}000 \times 113 = 1{,}240{,}000$ Btu available at an average pressure of $\frac{250 + 50}{2} = 150$ psig.

$h_{fg}$ at 150 psig = 856 Btu per lb

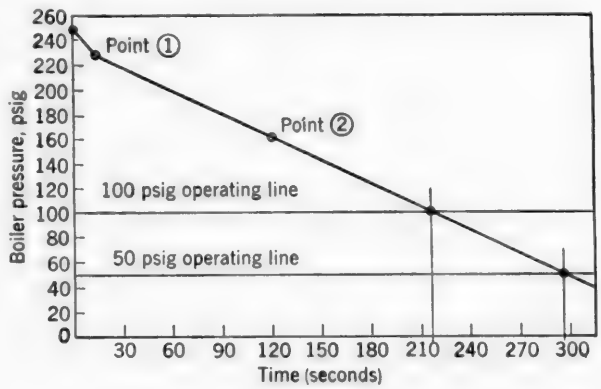



Fig. 2. Residual heat supply. Turbo operating curve.

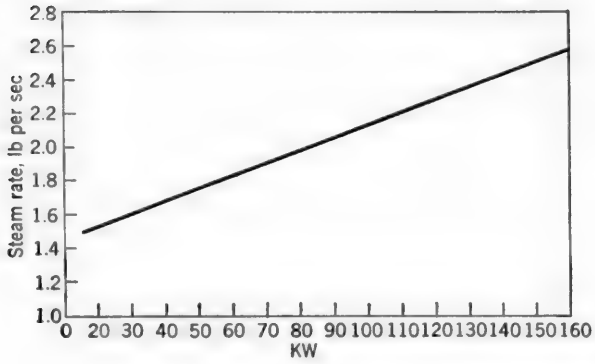



Fig. 3. Willans line for 150 kw turbo-generator.

$$\frac{1,240,000}{856} \quad 1,450 \text{ lb steam available}$$

Assuming that it requires 15 seconds from the time of power failure to the time of electric generation, the following then is the steam consumption for the period:

Boiler feed turbine:

.866 lb per sec × 15 sec = 13 lb

Emergency turbo-generator:

5 lb per sec × 15 sec = 75 lb

Total consumption: 88 lb steam

Therefore, at load cut in time (+15 sec) the available steam will be 1450 − 88 = 1,362 lb.

Heat consumed: 88 lb × 823 Btu per lb = 72,500 Btu

($h_{fg}$ = 823 Btu per lb at 240 psig)

$$\frac{72,500 \text{ Btu}}{11,000 \text{ lb}} = 6.5 \text{ Btu per lb}$$

$h$ at 250 psig = 380.0 Btu per lb

less 6.5 Btu per lb

Residual heat is 373.5 Btu per lb which corresponds to a pressure of 228 psig.

Therefore, at load cut-in time the boiler pressure will be 228 psig. This indicates a drop in boiler pressure of 250 − 228 = 22 psig in 15 seconds. 228 psig and 15 seconds locates point (1) on the curve, Fig. 2. The total heat remaining may now be computed as 373.5 (11,000 − 88) = 4,040,000 Btu.

The turbo-generator loading schedule must be predicated on cutting in the essential services in a predetermined sequence. The criteria for determining the standing in this sequence are (1) essential boiler equipment and building services, and (2) in sequence other items on emergency service according to the particular function of the building.

The following items comprise the initial load to be impressed on the turbo-generator:

| *Item* | *Running Kw* | *Starting Kw* |
|---|---|---|
| Forced draft fan | 12.90 | 22.8 |
| Oil burner controls | 0.50 | 0.5 |
| Emergency lighting | 7.50 | 7.5 |
| Oil pump | 1.44 | 2.9 |
| Total | 22.34 | 33.7 |

From the Willans line curve (steam vs. load) for the turbine (Fig. 3) the steam rates at starting and running loadings are 1.62 and 1.54 lb per sec respectively. Therefore, to meet the inrush of the initial load, the turbo-generator will have to reach speed and maintain steam consumption of 1.62 lb per sec for approximately 10 seconds. This period of time is necessary as the governor must bring the turbo-generator back to an even output level after over shooting when the load cut in point has been reached.

A water tube boiler of the packaged type operating under a normal starting cycle will require a period of approximately 1.75 minutes (105 seconds) to develop a steam generation rate equal to the steam demand of the two turbines. This time is predicated on the normal control sequence starting period of 10 seconds including necessary purge intervals. Therefore, the total turbo-generator steam consumption for this period equals:

10 seconds × 1.62 lb per sec = 16.2
95 seconds × 1.54 lb per sec = 146.0
Total 162.2 lb

The boiler feed pump turbine steam consumption for this period equals: 105 seconds × .866 lb per sec = 91 lb. Therefore, the total amount of steam used for this period is: 162.2 + 91 = 253.2 lb, say 253 lb.

The heat consumption in Btu can be computed if an average pressure is assumed for this time interval. A few trial and error solutions produce the result that a pressure of 200 psig would be a fair average for this period. Therefore, we have:

H at 200 psig = 1199 Btu per lb
1199 × 253 = 303,000 Btu

For this 105 second period the mass out-flow from the boiler was 253 lb. The mass in-flow to the boiler will then also be 253 lb. Since the house pump is not running during this period, the feedwater will come from the deaerating tank as the approximate temperature, 210 deg F, normally maintained in the heater tank. Heat added with makeup will be:

253 (210 − 32) = 45,000 Btu

We may now solve for the terminal pressure at time 15 + 105 = 120 seconds after power failure.

Heat available = 4,040,000 Btu
Heat consumed = 303,000 Btu
Heat added = 45,000 Btu
Net heat remaining = 3,782,000 Btu

$$\frac{3,782,000 \text{ Btu}}{11,000} = 344 \text{ Btu per lb} = 161 \text{ psig}$$

This pressure (161 psig) and 120 seconds locate point (2) on the operating curve, Fig. 2.

Now that two points have been established the operating curve is defined. By extrapolation it is determined that it takes 216 seconds for the pressure to fall to 100 psig and 296 seconds for the pressure to fall to the lowest possible operating point of 50 psig. From the curve it can be seen that there is approximately 5 minutes' supply of steam available based on no additional steam generation. This indicates that the cycle margin of safety is ample, and if the system is run periodically for short intervals there should never be a disruption of essential building services due to a power failure.

LOUIS BLENDERMANN ON

# PIPING AND PLUMBING

## "Wet Columns" in Multi-Story Buildings

MULTI-STORY buildings, such as large office buildings, are unlike most similar structures in that they are designed for varying types of occupancy. Other buildings, in general, are designed for a specific type of use which will more or less remain the same for the life of the building. Alterations, after a period of years, might be made to this structure but nevertheless, the occupancy will remain the same.

Multi-story buildings are especially designed to permit different types of occupancy or a change in the initial occupancy. For example, when the building is first planned, an insurance firm may sign a long lease for the entire fourth floor space. Therefore, this particular floor is laid out and arranged for the convenience of the insurance company. With the passage of years, the insurance company may decide to terminate its lease and relocate elsewhere, leaving the owner of the building with an entire floor to rent.

If the owner finds it too difficult to rent this entire floor he may subdivide this space to suit two or more tenants. To accomplish this, it is often necessary to erect partition walls adequately to divide the space for the tenants' needs. This is the reason why office buildings are different from all other building types. Each floor area is so designed to include the special arrangement or space subdivision. The speedy erection and removal of partitions is an asset to the owner and is a procedure that must be considered to suit the changing needs. Flexibility in arrangement of the spaces is one of the key factors to be considered when a multi-story office building design is contemplated. It is this flexibility that insures the owner an economical and modern building.

### Water and Waste Facilities

Toilet rooms originally provided on each floor of the building will not alone suffice for the individual needs of certain tenants. Therefore, consideration must be given to water and waste connections to be installed in specific locations on each floor, preferably at the concrete or building columns. Such facilities will permit the easy hook-up of water and waste to fixtures desired by the tenant. Figure 1 shows a typical layout of the floor area including the toilet rooms. In addition, the various columns have been spotted to show their proximity to the rentable space. Certain columns were selected to include water and waste facilities and these are known as "wet columns."

These particular columns were chosen because they are the ones most favorably situated for the overall space conditions. Moreover, it is at these columns where partitions are most generally erected. Water and waste facilities at such locations offer facilities that can be readily adapted to satisfy any desired arrangement of floor space or partitions. If necessary, this piping can be arranged to suit as many as four adjoining office spaces.

This is the type flexibility needed in multi-story buildings to serve the needs of the tenants and the expected functions required by the owner. It is not too difficult to determine just which columns would be ideally suited for this purpose and the engineer on cooperation with the architect can usually work out the most practical locations. It is possible that the owner may have definite thoughts on this subject.

### Type of Facilities

To provide adequately for the ultimate number of fixtures installed, the engineer should first make sure that the facilities are properly arranged.

Figure 2 illustrates a typical layout of the required facilities. Five lines are shown—a vent line, waste line, cold water line, hot water line and a hot water circulating line. All of these lines are plugged as shown. When these connections are to be tied in, the plugs are removed and the waste, vent and water lines extended to the fixture to be served. It is good practice to consider the use of plugs that can be removed easily. Water lines are equipped with valves that are plugged to assure positively against leakage. The valves can be either exposed or concealed in the pipe space. Since it is generally considered better practice to conceal the valves, it is also good design to include an access door to gain entry to the valves. When valves are concealed behind a locked access door, there is little chance for tenants to tamper with the valves.

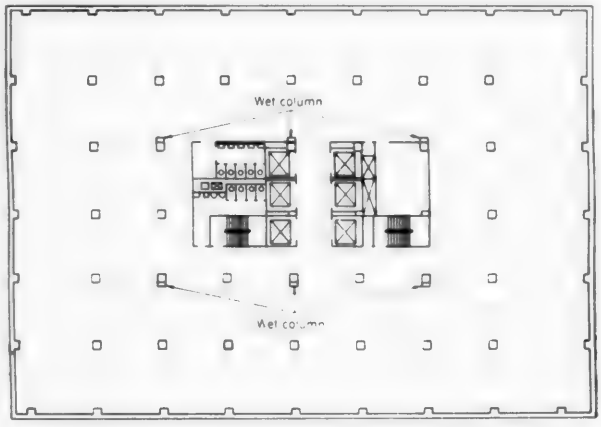



Fig. 1. Typical arrangement of floor area in a multi-story building, showing location of "wet columns."

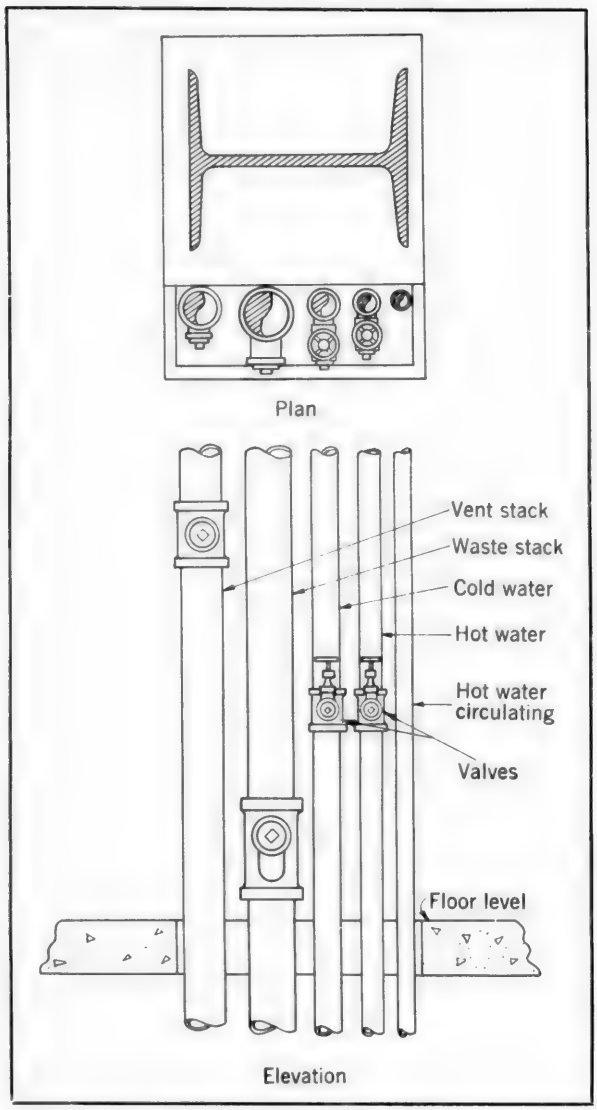



Fig. 2. Plan and elevation of typical arrangement of facilities at a wet column.

The arrangement of facilities in Fig. 2 shows an upfeed cold and hot water system of piping. This arrangement is for the purpose of example only. If the building were any taller, a downfeed system of cold and hot water piping would be in order. In general, these lines are arranged in accordance with tl.e particular water system design that the engineer contemplates using for the particular type and size of multi-story building.

If a down feed system of cold and hot water is planned, then the hot water circulation line is not needed. In any event, sufficient room must be provided in the pipe space at certain floor levels for the installation of sectional valves to control the water in the vertical risers as well as for pressure reducing valves that are required for the vertical risers in tall buildings.

All of these conditions must be carefully studied during the design stages of the project.

## Spacing for Facilities

Proper spacing for the facilities is a factor that also requires study. This is quite an important design phase because it determines the amount of room required in the pipe space for the proper installation of the vertical lines as well as for the connections provided on the risers. Since the columns are limited as to size, a little study is needed for the proper placement of the lines in the space allowed. Both the architect and the structural engineer must know the amount of room to allow at the columns for the installation of the necessary facilities.

Another important consideration is provision for the passage of piping through the slab. This is accomplished by either a slot or individual holes cut in the slab. The structural engineer should be consulted on this detail to avoid weakening the slab. The particular type of slab construction used determines whether proper reinforcing must be provided. Reinforced concrete slabs, beam and arch slabs and preformed steel slabs all require special attention to insure adequate slab strength.

## Size of Facilities

The size of the vertical risers and the individual connections provided at each floor depend upon the greatest anticipated fixture load expected on each floor and the height of the building. If only drinking fountains are to be installed at each floor, it is necessary to know the number that will be connected at each floor level. If several fixtures, including lavatories or small sinks, are to be installed, the piping must be sized for this enlarged capacity.

Water closets are not usually installed at wet columns; however, if the owner feels that he would like to include water closets at some later date, then it is necessary for the engineer to size his system accordingly. The wet columns must be designed to meet the present and future ultimate needs of the specific installation. Each project is an individual one and demands individual treatment. The size of the vertical waste, vent and water risers, therefore, must be sized to conform with the particular needs of the project as well as with the requirements of the governing local code. Only in this manner will the proper system of facilities be included.

## Vertical Arrangement of Piping

Facilities that comprise wet columns must be handled in the same manner as the sanitary system that serves the general building fixtures.

Figure 3 is a schematic diagram of a typical arrangement of wet columns. On this illustration are the water, waste and vent lines. They run from the highest story of the building down to the level where they connect with the horizontal water and drainage lines in the building. For the purpose of example, a 12-story building was used. If the building were any higher, the system would be of the down feed type and the hot water circulating line deleted. The water system design selected depends upon the engineer.

For the system shown, note that valves are placed at the base of the cold, hot and circulating risers. These control the risers themselves. If it is desired, because of the height or water pressure in the building, to sectionalize the water supply, then valves could be placed at, say, the fifth story to control the upper stories. If such control valves are needed, the space within the wet column should be large enough to contain them.

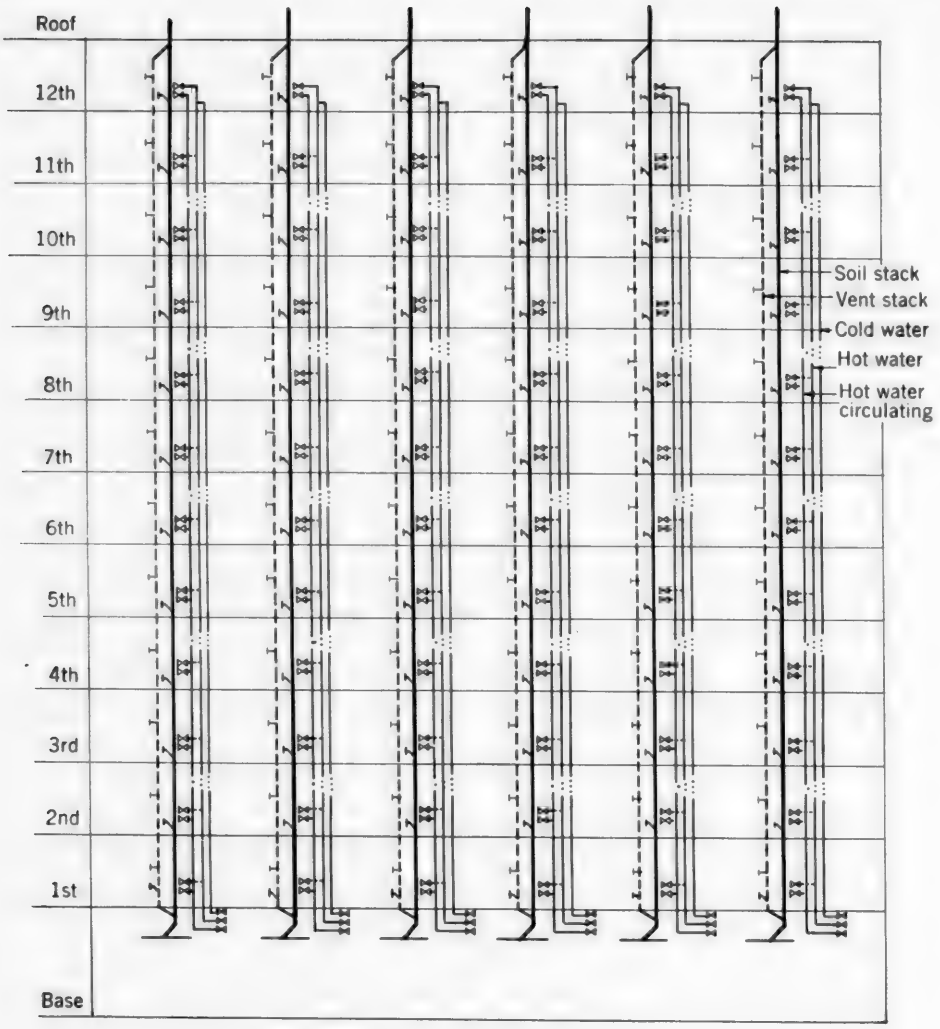



Fig. 3. Riser diagram showing arrangement of facilities in a wet column.

The same attention must be given to the piping contained in the wet columns as is given to the piping systems. Therefore, supports should be placed at least at every other floor as shown in Fig. 4.

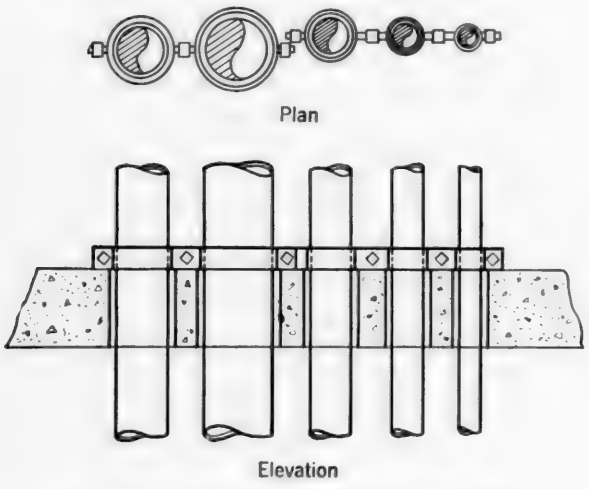



Fig. 4. Supports for pipes passing through slab.

Facilities are shown in Fig. 4 passing through holes cut in the slab. Therefore pipe clamps are used to support the individual lines. The pipe clamps generally are placed at every second or third floor level to carry the weight of the piping, dependent of course on the diameter and weight of the piping itself. If slots in the slab are provided for the passage of the piping, then pipe clamps would again be used, except that the clamps would be so placed to straddle the slot. In any event, it is very important that some means of support be used in order to prevent the stress due to the weight of the main piping from being transmitted to the branch piping.

## Piping Material

A selection of materials is available for the waste, vent and water piping. Choice of type and material for water piping depends upon the particular characteristics of the water. The waste and vent stacks can be cast iron, galvanized wrought iron, or copper tubing. The relative economy of the project, as well as the expected life of the building, are important factors to guide the engineer in determining the material he will use. In every case, the matter should be carefully studied so that the system will enjoy long life and trouble-free operation.

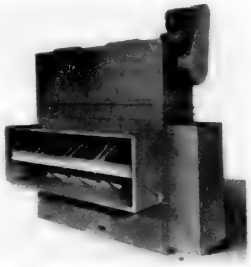
# NEWS OF EQUIPMENT AND MATERIALS

Use the convenient prepaid postcard appearing on page 85 for securing additional information on new equipment and materials described in this department.

## Commercial Air Conditioner

A 20-ton unit is added to the line of floor type, commercial, packaged air conditioning units made by American Blower Corp., Detroit, Mich.

Designed for use with fully ducted installations, the new size forms a self-contained, central station type of air conditioner in the 20-ton cooling capacity range. It is recommended for use in restaurants, churches, small theatres, offices, banks, retail stores, markets, small factories, and shops. The company's packaged line now includes 3, 5, 7½, 10, 15, and 20-ton sizes.



In addition to the 208/220-v, 3-phase, 60-cycle arrangement, which is still available for all units, a 440-v, 3-phase 60-cycle arrangement is now optional for all sizes, and a 230-v, single-phase, 60-cycle arrangement can be specified for 3- and 5-ton units. The current and voltage flexibility provided by the new options enables the architect, engineer, or contractor to specify the most suitable arrangement for a given installation.

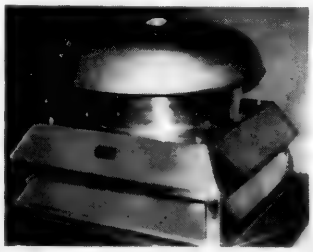
The same features of the smaller sizes are also included in the new 20-ton unit. Accessibility of working parts for maintenance and service is also a design feature of the new size.

More information? Circle Item 1 on postcard, page 85.

## Centrifugal Ventilators

Direct and V-belt (illustrated) driven models of the Uno-Venturette centrifugal, roof ventilator are announced by Uno Ventilator Co., Malden, Mass.

The addition of the two new models expands the line of aluminum, power roof exhausters so that it now includes over sixty models ranging in capacity from 245 to 18,000 cfm.



The direct driven model is available with capacities from 245 to 4220 cfm at zero static pressure. The V-belt driven model is available with capacities from 1350 to 18,400 cfm, also at zero static pressure. Direct driven axial models are also made by the company.

Both centrifugal models have backward curved impellers and square mounting frames for installation over roof curbs.

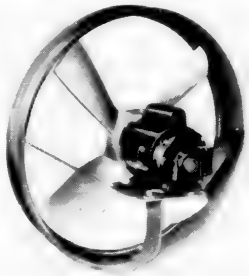
Catalog 56, published by the manufacturer, lists the specifications and characteristics of the ventilators.

More information? Circle Item 2 on postcard, page 85.

## Axial Flow Fans

A line of direct-connected axial flow fans has been designed for air moving applications requiring low noise level operation by Propellair Div., Robbins & Myers, Inc., Springfield, Ohio.

Designated as Type QD by the manufacturer, the fans are designed for offices, stores, restaurants, laboratories, institutions, and other applications requiring the quiet movement of large volumes of air. They are available in six sizes from 12 to 36 in., with air delivery ratings to 12,000 cfm.



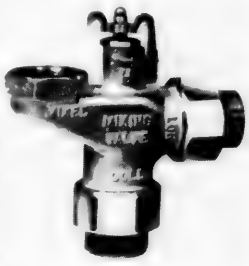
A cast aluminum, airfoil propeller operating at low speed accounts for the quiet operating characteristics of the fans. Non-corrosive, the propeller will operate continuously without the danger of bending fatigue generally encountered with pressed sheet metal blades. The thick airfoil design of the propeller also eliminates the sounding board effect of thinner sheet metal blades. The Venturi design of the fan's mounting ring prevents air recirculation at the propeller tips, thus reducing noise and increasing efficiency.

The fans are powered by totally-enclosed, continuous duty, 115/230-v, permanent split capacitor motors manufactured by the company with no centrifugal switches or brushes. The fans can be adapted for two-speed as well as variable speed operation with controllers. Wall shutters and front and rear wire mesh guards are also available.

More information? Circle Item 3 on postcard, page 85.

## Water Mixing Valves

Two water mixing valves, the No. VD-203 (adjustable) and the No. VD-205, are manufactured by Detroit Controls Corp., Detroit, Mich., to automatically control hot water temperatures at the fixtures by mixing hot and cold water in the proper proportions.



The valves reduce water heating costs and prevent the sweating of water closet tanks by replacing cold water with tempered water.

Both water mixing valves contain a sealed thermostatic element that provides sufficient force to operate the valve under all conditions. Sensitive to temperature changes, the element keeps mixed water temperatures constant despite changes in supply water temperatures.

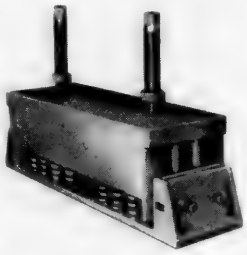
The adjustable VD-203 valve is available in two ranges: 70 to 130 deg F or 120 to 160 deg. The non-adjustable VD-205 valve is set at the factory. Both are made of corrosion-resistant phosphor bronze, Monel metal, and stainless steel.

A descriptive folder, Form 1689, is available.

More information? Circle Item 4 on postcard, page 85.

## Heavy Machinery Mounts

A high capacity vibration, shock, and noise isolator which permits direct mounting of heavy machinery without special chasses or foundation has been developed by The Korfund Co., Long Island City, N. Y.



Designated the SK/50,000 Vibro-Isolator, the unit is rated at 75,000 lb for steady running applications and 50,000 lb for impact applications.

Direct mounting of presses and other machines weighing up to 300,000 lb is feasible and economical, using four of the new isolators and without heavy foundations.

The isolators consist of heavy-duty, welded steel housings containing oil-tempered, high carbon or chrome-vanadium helical steel springs as the isolation medium. The upper and lower members of the housing are held in their relative positions against lateral movement by resilient chocks which take up horizontal thrusts and which can be adjusted for varying degrees of damping to limit vertical and horizontal oscillation under both vibration and impact. Two dual-purpose bolts in the top housing secure the mounting to the machine and provide a means for leveling the installation, thus eliminating the need for leveling jacks, shims, or wedges.

Detailed drawings of the isolator are available.

More information? Circle Item 5 on postcard, page 85.

## Industrial Hose Fittings

Two new products, push-on fitting (illustrated) for low pressure use on water, fuel, or lubrication lines, and a two-bolt clamp fitting for high pressure applications on steam hoses or LP gas lines, have been developed and are being marketed by Flex-O-Tube Div., Meridan Corp., Inkster, Mich.

The push-on fitting is made of brass, comes in ¼, ⅜, and ½-in. sizes and is designed for use with a P54 rubber-covered hose for low pressure uses up to 250 psi. The fitting is assembled dry or with water as a lubricant by pushing the hose over twin ferrules on the fitting stem. A feature of the fitting is that it permits shop and maintenance personnel to make hose replacements without removing the fitting from a machine.

It is made in six types: rigid male pipe; swivel female SAE 45-deg flare; swivel female SAE 37-deg flare; swivel male inverted nut; rigid male SAE 45-deg flare; and rigid female inverted fittings.

Called Dynalok, the clamp fitting is made of heavy malleable iron and is secured by two large heat-treated bolts. It is a reusable fitting that also permits maintenance personnel to leave the fitting on a machine and insert a new hose over the fitting stem. It is made in eight sizes to accommodate hose from ¼ to 2 in. in diameter. The triple wire braided hose and clamp are rated for pressures up to 3000 psi; with a double wire hose, it is also rated up to 3000 psi; with single wire hose it has a 2500 psi rating; and used with a two fiber braided hose, 1500 psi.

More information? Circle Item 6 on postcard, page 85.

## Adjustable Cone Diffuser

A ceiling air diffuser (Model RC) with adjustable inner cones is added to the line of commercial, industrial, and residential ceiling diffusers made by Carnes Corp., Verona, Wis.

The inner cones of the diffuser may be positioned to secure 4, 3, or 2-way (left to right in photograph) corner discharge patterns without disassembling the diffuser or using tools. The pattern change is made by sliding the inner vanes to the position desired.

An air inlet may be entered in any location in the ceiling, and the diffuser adjusted for the desired air distribution pattern to obtain satisfactory performance.

The diffuser is available in two sizes with a 6 x 6-in. or an 8 x 8-in. square neck. It can also be secured with an integral opposed blade damper that is adjustable from the face of the diffuser.

Information describing the new diffuser is available in Catalog R-86.

More information? Circle Item 7 on postcard, page 85.

## Commercial Air Conditioners

A modernized line of commercial, packaged air conditioners is announced by The Trane Co., La Crosse, Wis. The line includes sizes ranging from 3 to 20 tons.

Some features of the self-contained units are: a fresh air intake which bypasses the compressor section; a one-piece plenum chamber; the fan motor mounted out of the heated air stream; and the condenser arranged for a single set of piping connections.

The cabinets are designed to blend with interior decoration schemes. The overall dimensions of the cabinets have been reduced.

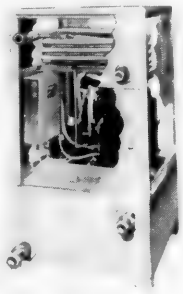
Construction features include a single piece front panel which can be released by catches at the top of the unit; controls concealed behind the nameplate for access, yet sufficiently hidden to prevent casual tampering by unauthorized persons; a retainer chain between the front panel and the unit that allows the panel to drop back for changing the filter (for service work, the entire front panel is removable); and a fan section which may be blocked off to permit service to the refrigeration cycle without upsetting operating conditions.

Further details about selection and roughing-in dimensions are given in Bulletin DS-362.

More information? Circle Item 8 on postcard, page 85.

## Packaged Water Chillers

A line of packaged water chillers, which require less than 4 sq ft of floor area, is introduced by Drayer-Hanson, Inc., Los Angeles, Calif. When the future expansion of a building's facilities calls for greater cooling capacities, a nesting feature of this line will allow the packaged chillers to be set on either side of an existing installation, or behind it, to give increased tonnage, when and as needed.



Available with either water (AC-5200 and 5300 Series) or air-cooled (WC-5200 and 5300) condensers, the self-contained chillers are designed for small commercial, industrial, and residential applications calling for chilled water air conditioning or industrial water cooling applications. Two- and three-ton models are now available, with larger capacities expected to be announced, shortly.

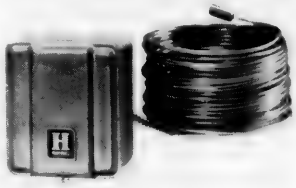
Both the air-cooled and water-cooled models make use of a thermal expansion valve; a refrigerant dryer and strainer; a liquid line sight glass; and a Tecumseh hermetic compressor charged with Freon-22. The controls consist of a thermostat, a compressor motor contactor, a water circulating pump, a pressure control, and a cooling switch.

Both lines have copper, chilled water coil circuits. The air-cooled models require no condenser water; may be installed wherever adequate ventilating is provided; feature a steel fin-and-tube condenser; and are sized to operate in ambient temperatures up to 120 deg F. Their discharge arrangement is top vertical. The water-cooled units will take city water or cooling tower water.

More information? Circle Item 9 on postcard, page 85.

## Thermostat Has 27-Ft Element

An electronic thermostat that features a 27-ft temperature-sensing element is introduced by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. It is designed to solve the problem of temperature stratification in large air ducts.



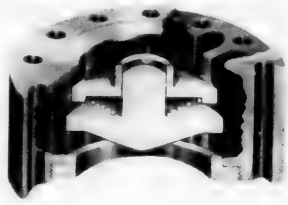
The long temperature-sensing wire is enclosed in ⅛-in. copper tubing. This permits it to be arranged to sense the average of stratified temperature such as those that exist in large heating and air conditioning ducts in commercial buildings. It can also be used to give average readings of concrete slab temperatures in radiant floor, panel heating systems.

Designated L7022A, the instrument has an operating range from −30 to 225 deg F. It can be used with any standard M-H electronic or electronic-pneumatic control system.

More information? Circle Item 10 on postcard, page 85.

## Valve Controls Water Hammer

A flanged, check valve for the control of water hammer has been developed by The Williams Gauge Co., Inc., Pittsburgh, Pa. Named Williams-Hager, the check valve is recommended by the manufacturer for the control of water hammer for all types of hot or cold liquid service—including water, oils, gasoline, acids, chemicals, salt water, and brine—where the liquid flow is constant.



The valve is available in sizes from 1 to 10 in., faced and drilled in accordance with ASA standards for pressures ranging from 125 to 2500 lb. The valve can be furnished with special flange facings, including large male and female, ring joint, and large tongue and groove.

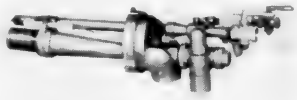
Among the design features of the unit are a removable and renewable disc and seat and a conical spring. The valve can be used in any position.

More information? Circle Item 11 on postcard, page 85.

## Radiant Tube Burners

A series of radiant tube burners has been designed by Eclipse Fuel Engineering Co., Rockford, Ill., for application to radiant heating tubes used in industrial furnaces and ovens for the distribution of indirect heat. The burners operate on an air pressure of approximately eight ounces and low pressure gas, normally below ½ lb.

Designated RT, the tube burners are equipped with a single air supply opening, which has an external adjustment making it possible to vary the amount of primary air to be mixed with the gas, as required. The gas and primary air begin combustion at the end of an alloy nozzle in a secondary air stream. By reducing the velocity of the gas and air flow, a long, slow burning flame is secured which gives uniform heating through a long length of tube.



Lighting the burners can be accomplished in one of several ways. With the air turned down and the gas on, the burner can be lighted by applying a torch to the discharge end of the radiant tube and allowing the ignition to flash back to the burner nozzle. Another method is to use a spark plug igniting the main flame direct from the back of the burner. A third method is to use a blast-type pilot which may be continuous or intermittent, as desired.

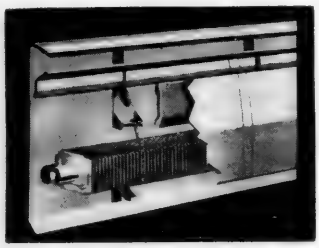
The burners can be operated automatically over the entire range of their capacity, if they are equipped with an automatic air-to-gas ratio control. This can be done by applying the company's NM proportionators to the burners either singly or in groups.

Though made in two sizes, by use of adapter castings, the burners can be utilized to fire radiant tubes with outside diameters ranging from 3¾ to 8½ in. They will fire from 250,000 to 400,000 Btu per hr operating on 8-oz air.

More information? Circle Item 12 on postcard, page 85.

## Baseboard Heating Panels

With the addition of Model 75-B, non-ferrous baseboard heating panels are available in popular sizes for all applications from Plumbing and Heating Div., American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.



Named High-Capacity Heatrim, the panel is designed to produce a higher output per lineal foot—1000 Btu per hr with 220-deg F water—through greater air flow and increased stack effect. It utilizes the same element presently furnished for the Model 75-A Standard panel and is $2\frac{3}{4}$-in. deep.

Both models feature a $\frac{3}{4}$-in. annealed copper tube with mechanically bonded aluminum fins. Model 100, a third model, has a 1-in. tube for larger water-carrying capacity.

The Model 75-B panel is suitable for installation in rooms with excessive heat loss due to large cold walls or glass space. It replaces conventional baseboard with a continuous line of panels around the perimeter of the house. Constructed sturdily in 4, 6, and 8-ft lengths, the panel may be installed either against the wall or recessed to the depth of the plaster.

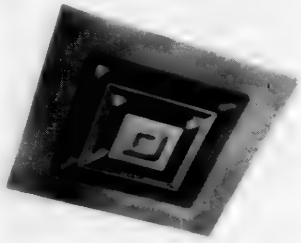
Made of 20-gage sheet steel, the baseboard enclosures permit recessed installations without building paper or metal foil backing. The design and location of the air vane increases outlet efficiency and guides heated air in the proper direction for best circulation.

Damper assemblies feature individual panel control. The damper operates with a knobbed slider assembly and is installed by slipping it into a notch in the support bracket.

**More information? Circle Item 13 on postcard, page 85.**

## Supply and Return Diffuser

An air diffuser for use where air is to be both discharged and returned through a single unit is being made by Connor Engineering Corp., Danbury, Conn.



Designated the Kno-Draft Type KPSR, the square diffuser is geometrically proportional throughout all sizes. At constant neck velocities the static pressure for any unit will not vary in order to produce uniform diffusion patterns over a large area.

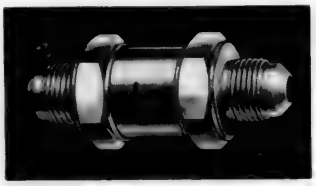
Air is discharged between the outer and middle cones and return air is drawn through the center section, which has a neck area equal to 75% of the supply. This design prevents short circuiting of the supply air into the return opening.

All sizes may be obtained with the company's patented, sleeve-type damper.

**More information? Circle Item 14 on postcard, page 85.**

## Refrigerant Check Valve

A check valve primarily designed for application on the high pressure side of refrigerating and air conditioning systems, but may also be adapted for low side use, is offered by Remco, Inc., Zelienople, Pa.



When used on the high pressure side of an automobile air conditioning system—or for any other air conditioning or refrigerating system—the check valve is made of steel in order to keep costs down. Check valves are also obtainable in brass for low side applications where there is a chance of frosting or sweating. The seating plugs are made of Nylon.

The valve body, seating plug, seating plug retainer, and spring comprise an integral unit. This means that any complement of end fittings may be provided, including flare by male flare, male flare by female flare, or any combination of flare by sweat connections on both ends.

**More information? Circle Item 15 on postcard, page 85.**

## Insulation Fuses to Pipe

A blend of natural hydrocarbon material, called Insulite, which insulates and protects underground pipe from corrosion is available from G. S. Zeigler & Co., New York, N. Y.

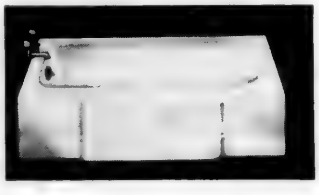
To install the insulation, it is not necessary to wrap the pipe. The material is filled into the area around the pipe, and, when steam is introduced into the pipe, the material fuses itself to the pipe and forms a protective coating of insulation.

Mined in Utah, the hydrocarbon material is available in various grades of melting points and sizes which are blended to form the insulation. Grade I has a temperature range from 220 to 290 deg F; Grade II has a temperature range from 291 to 350 deg F; and Grade III has a temperature range from 351 to 500 deg.

**More information? Circle Item 16 on postcard, page 85.**

## Recess Bathtub Has Seat

A 14-in. high, recess bathtub with a seat is manufactured by The Humphryes Mfg. Co., Mansfield, Ohio. The seat is $4\frac{1}{2}$ in. wide and 30 in. long and is located at the top of the front panel.



Made of enameled cast iron, the bathtub is 60 in. overall in length, $13\frac{1}{8}$ in. deep inside, $28\frac{3}{4}$ in. wide at the ends, and $29\frac{3}{4}$ in. wide at the seat.

Model 2401, which has a left-hand outlet, is illustrated in the photograph. Model 2400 has a right-hand outlet. Both models are available in white enamel or in any one of five pastel colors.

Descriptive literature, a catalog, and price information are published by the manufacturer.

**More information? Circle Item 17 on postcard, page 85.**

## Refrigerant Condensers

A line of shell and tube condensers, called the KY series, is announced by Standard Refrigeration Co., Chicago, Ill.

The condensing capacity of the condensers is 15,000 Btu per hp at 105 deg F condensing temperature, with either 1½ gpm per hp at 75 deg or 3 gpm per hp at 85 deg. An allowance for moderate fouling has been included. Another feature is that low water pressure drops make cross-connections for tower service unnecessary. Water passes can be drained through the lower (water inlet) fitting.

The manufacturer has prepared graphic performance charts which demonstrate the operating characteristics of the condensers.

**More information? Circle Item 18 on postcard, page 85.**

## Nylon Pipe Fittings

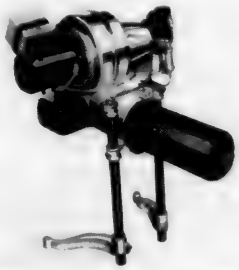
A line of Nylon fittings is being made by Chesflex Corp., Yonkers, N. Y., for use with its polyethylene pipe.

The company is offering the Nylon fittings in insert male adapters, insert 90-deg ells, insert couplings, insert tees, combination reducing tees, combination reducing ells, and two new sprinkler ells and sprinkler tees.

**More information? Circle Item 19 on postcard, page 85.**

## Oil Burner Line

A line of domestic and industrial oil burners ranging in size from 1 to 42 gph is announced by Synchronous Flame Inc., Walworth, Wis.



With this addition, the company now manufactures a complete line of dual-fuel, power gas and oil burners ranging in size from 100,000 to 4,600,000 Btu per hr. All of the line is UL approved.

All the dual-fuel and the new oil burners burn No. 1 to No. 3 fuel oil; all the dual-fuel and power gas burners burn manufactured, mixed, natural, and LP gases. All models utilize forced draft, electronic safety controls, and a patented firing head, designed to eliminate pulsation.

The gas, oil, or combination burners can be factory equipped to pressure fire Scotch marine boilers for stub stack operation.

**More information? Circle Item 20 on postcard, page 85.**

## Unit Purifies Exhaust Steam

A receiver-type purifier has been designed by V. D. Anderson Co., Cleveland, Ohio, for purifying exhaust steam so that it can be re-used for heat exchangers, unit heaters, or for heating or condensate. The unit is called Hi-eF and is designed for installation in exhaust steam lines from steam hammers, reciprocating engines, and other steam equipment.

Condensate, oil droplets, and other mist entrainment are intercepted from exhaust steam by means of a two-stage principle of separation incorporated into the receiver. In the first stage, the velocity of the exhaust steam is suddenly reduced as it enters the drum of the receiver. This sudden reduction in velocity, combined with the drum, drops out the larger droplets of condensate and other material. Then the exhaust steam is guided through a multi-stage separating element which removes the fine mist by utilizing controlled centrifugal action. Throughout the receiver the exhaust steam and removed liquid are continuously separated.

The manufacturer fabricates a complete line of the units for pipeline sizes from 4 to 16 in., for pressures up to 300 psig, and with various inlet and outlet arrangements. Standard receiver purifiers are designed, built, and stamped to the ASME code for unfired pressure vessels, have forged steel flanges, and bodies of welded steel construction, both to suit the pressure specified. Larger units and special designs are also available.

**More information? Circle Item 21 on postcard, page 85.**

## Unit Heaters Are Restyled

New enclosure styling, improved burner and heater exchanger design, light weight, and a wider range of sizes are among the features offered by the line of gas-fired, unit heaters announced by Modine Mfg. Co., Racine, Wis.

Emphasis has been placed by the company on the appearance of the units. Modern lines and graceful curves are employed in place of the former box-like appearance. The unit is finished in gray-green baked enamel and has a chromed, initialed medallion, diverter grilles, and signature panel.

The burners are made of stainless steel, are self-cleaning, and have elongated ports.

The heat exchangers are available in either stainless or aluminized steel. Each exchanger tube is individually and directly fired with a flame that extends continuously from the front to the rear to increase the radiant heat absorption and to distribute heat more uniformly throughout the length of the tube. Combustion air inlets are located directly beneath each tube to minimize flame disturbance.

The weights of the eight models available range from 35 lb for the 25,000 Btu per hr model to 292 lb for the 310,00 Btu per hr unit. The 310,000 Btu per hr model is a new addition to the line.

Protection against heat exchanger burnouts caused by excessive temperatures is provided by a dual safety control. Other controls have been simplified for added operating convenience and appearance. Automatic safety controls have been combined in the units, with single-unit controls used on smaller models and three-unit controls on the larger sizes.

**More information? Circle Item 22 on postcard, page 85.**

## Cooler for Meat Cutters

A room air conditioner—Model H 86 SC-White—has been designed for supermarket meat cutting rooms by Typhoon Air Conditioning Co., Inc., Brooklyn, N. Y.

Available in 3, 5, and 8-ton capacities, the air conditioner is engineered for lower than normal temperatures by means of an additional low temperature limit cutoff which prevents the cooling coil from freezing. It provides the low temperatures necessary for meat cutting room operations. Its construction provides a wide area of air circulation to prevent direct air currents from hitting the workers.

The cooling coil, silver-soldered at the joints, is constructed of seamless copper tubing with bonded helical fins.

Incorporated in the unit is a copper jet, counterflow condenser that utilizes the company's tube-within-a-tube design. It requires no change of circuits for city water or cooling tower operation. Where waterless operation is preferred, an air cooled condenser can be applied to unit.

Automatic operating controls are located in the front of the unit, concealed by a finger-lift nameplate. The control box consists of an adjustable thermostat and a selector switch which permit the operator to select *cooling, fan only*, or *off* positions. Built-in overload protection and a high-low pressure switch safeguard the equipment.

Approved by Underwriters Laboratories, the units are packaged ready for installation and are factory-tested before shipment.

**More information? Circle Item 23 on postcard, page 85.**

## Probe Pyrometer

A hand-held, probe pyrometer, for use in non-corrosive metallic and non-metallic liquids, and in atmospheres of furnaces, kilns, ovens and other high heat containers is available from Pacific Transducer Corp., Los Angeles, Calif.

Designated Model 321, the pyrometer can be used in heavy duty service. It has a chrome-plated case and handle. The chrome finish provides an external reflective surface that prevents the absorbtion of heat, which would normally change the cold junction temperature.

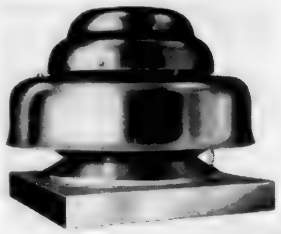
A calibrating thermometer is built into the unit and is positioned in the immediate vicinity of the cold junction. This arrangement provides a more accurate means of calibration for the cold junction.

The thermocouples are insulated by refractory bead of the closed end type. The probe is 19 in. in length and comes in two types. One couple has a range to 2300 deg F, and the other couple has a range to 1600 deg. The thermocouples may be replaced. The D'Arsonval Meter movement has a 2⅔-in. length of scale and an adjustment screw for the cold junction temperature.

**More information? Circle Item 24 on postcard, page 85.**

## Centrifugal Fan Ventilator

A centrifugal fan unit called Airlift is being manufactured by The Swartwout Co., Cleveland, Ohio, to exhaust ventilation ducts serving relatively small spaces.



Made in five throat sizes, the direct drive roof ventilator is listed in a range of twenty-nine capacity ratings suitable for various combinations according to the static pressures involved. The unit is made entirely of aluminum, including the fan wheel, which is non-overloading. It mounts on a low curb on the roof.

Form No. 304 gives the dimensions and capacities of the new ventilator.

**More information? Circle Item 25 on postcard, page 85.**

## Self-Aligning Tube Fitting

A self-aligning tube fitting is placed on the market under the trade name Selfalign by The Weatherhead Co., Fort Wayne Div., Fort Wayne, Ind.

An advantage of the fitting is that it can be installed without the necessity of disassembling it. Tubing is inserted in the fitting until it bottoms and the nut is tightened. The sleeve grips the tubing over a sufficiently broad area for a surface-to-surface seal, while a thin edge and guiding shoulder form a line-to-line seal with the tubing as the nut is tightened.

The fitting is suitable for instrumentation and other low and medium pressure applications using copper and aluminum tubing. The complete line includes union, union tee, union elbow, male and female connectors, male and female elbows, and male tees for pipe on run and pipe on branch.

Sizes ⅛, 3/16, ¼, 5/16, ⅜, and ½ in. in brass are available from stock; aluminum fittings are made to order.

**More information? Circle Item 26 on postcard, page 85.**

## Cement Water Heater Lining

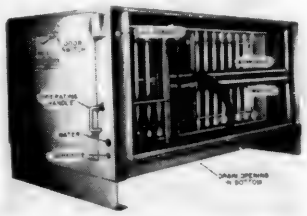
A cement-base lining for plain steel water heaters and storage tanks is made by Pocono Fabricators, Inc., a division of Patterson-Kelley Co., Inc., East Stroudsburg, Pa. The company expects the lining, called C-17 Pre-Krete, to lengthen the service life of steel water heaters and storage tanks by halting corrosion.

The mixture resists thermal shock, shrinking and cracking at high and low temperatures. It prevents rusty water conditions by preventing galvanic action within the tank. Its application requires no special tools, and a tank can be completely lined and restored to service in 48 hours or less.

**More information? Circle Item 27 on postcard, page 85.**

## Packaged Air Cleaner

A packaged, electronic air cleaner, Precipitron (Type PC), for commercial and industrial application is available from Westinghouse Electric Corp., Sturtevant Div., Boston, Mass. Requiring a space of 38 in. in the direction of air flow, the unit incorporates movable washing and adhesive applications that are usually found only in larger units.



Both the washing and adhesive application cycles are controlled and operated from outside the unit. The air cleaner comes fully enclosed with a built-in drain pan, drain connection, and duct flanges and has provisions for mounting on a ceiling, floor, or platform.

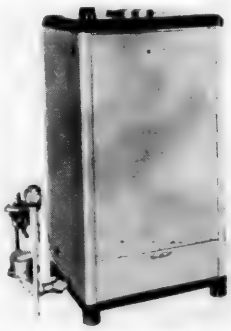
The capacities of the packaged cleaner models range from 2000 to 10,640 cfm. However, the length in the direction of air flow is the same 38 in. for all units. The 2000-cfm unit has a height and width both of 35 in.; the 10,640-cfm unit has a height of 61 in. and a width of 91 in. The electrical input required is 115v, single phase, 60 cycle.

More information? Circle Item 28 on postcard, page 85.

## Commercial Water Heater

A heavy duty, multi-coil gas water heater is being made more compact by Ruud Mfg. Co., Kalamazoo, Mich.

Designated Model 500A, the heater is designed for use with an auxiliary storage tank in a variety of commercial and industrial water heating applications where natural, mixed or manufactured gas is available. The American Gas Association's laboratories have approved the unit product as a circulating tank water heater, and it has also been approved by the Associated Factory Mutual Insurance Companies for use with sprinkler systems, to prevent freezing. When installed, singly or in multiples, with auxiliary horizontal or vertical storage tanks from 100 to 3000-gal capacity, the heater can provide hot water service for apartment houses, hotels, the larger motels, auto-wash stations, industrial plants, and such institutions as school dormitories, and hospitals. It can be used for tempering water in outdoor or indoor swimming pools and can raise tank water to the desired temperature for baptistries. In certain commercial and industrial processes, fluids can be circulated through the unit.



The heater contains seven horizontal coils formed of 15-gage copper tubing. All are independently removable. The coils meet a manufacturing test pressure of 355 psi, and a working pressure of 150 psi. The other waterways in the heater are made of copper to prevent rust and corrosion at all temperatures. Burners beneath the coils are bunsen type with brass flame checks. A 2-in. blanket of Fiberglas insulation surrounds the combustion chamber and stainless steel flueway. A steel jacket with a two-tone gray finish, encases the water heater, which requires 30 by 38 in. of floor space.

The unit has a 460,000 Btu per hr input. The gas line connection is 1¼ in.; water inlet and outlet are 2½ in.; and flue opening is 8 in. The recovery rating of the gas water heater is 645 gph at a 60-deg F rise, 484 gph at an 80-deg rise, and 387 gph, at a 100-deg rise.

Controls furnished with the heater include an electric diaphragm gas valve, a low voltage transformer, a gas pressure regulator, a high limit temperature control, a thermostat, a pressure relief valve, and an automatic pilot.

More information? Circle Item 29 on postcard, page 85.

## Panels Heat from Ceiling

Ceramic radiant heat panels that can be suspended from the ceiling are available from Heatmore, Inc., Brooklyn, N. Y., for use in commercial and industrial applications or wherever wall and floor space is limited.

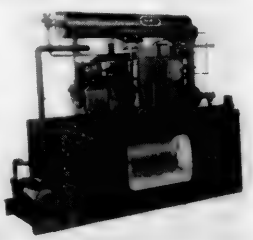
Model No. FD-1 is a 1035-watt panel (9 amps at 115v, or 4.5 amps at 230v) and, although standardly supplied with two 12-in. stems and canopies, may also be had with longer suspension rods, or with chains instead of rods. In normal application and for greatest comfort, the panels should be suspended about 9 ft from the floor. The unit is 24¾ x 23¼ x 2 in., and is controlled by a separate, wall-mounted thermostat.

The radiant heat panels consist of a ⅝ in. thick special composition molded with nickel-chromium resistance wire completely imbedded inside.

More information? Circle Item 30 on postcard, page 85.

## Liquid Chillers

A line of packaged, liquid chillers, called PCS, with storage tanks is introduced by Heat-X, Inc., Brewster, N. Y. The units are designed for use wherever peak demand conditions occur: in supplying drinking water for schools, hospitals, theaters, offices, and for a variety of industrial applications. Featuring the company's patented Inner-Fin construction, the chiller is coupled with an insulated, stainless steel tank and furnished mounted, piped, and ready to install.



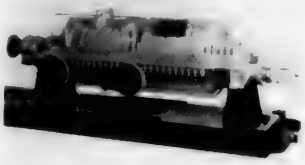
Copper or brass is used for the water passages in the chiller, condenser, and water piping to avoid the possibility of rusty water.

Units are available in air-cooled models. Capacity controls can be supplied.

More information? Circle Item 31 on postcard, page 85.

## Boiler Feed Pump

A boiler feed pump for medium size power plants is announced by Byron Jackson Div., Borg-Warner Corp., Los Angeles, Calif. It is available in capacities to 2200 gpm and heads to 3000 ft.



Designated Model DVMX, the pump has a horizontally-split, double volute design that produces a radial balance of the pump at all capacities. The volutes and water passages between stages are an integral part of each casting. The impellers are arranged in equally opposed groups to produce an hydraulic axial balance and eliminate the need for high pressure drop, balancing devices.

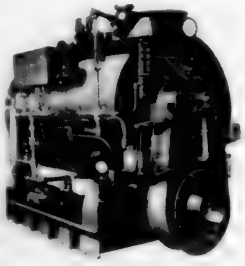
Nozzles are located in the lower half of the pump, permitting removal of the top half and rotating element without disturbing the piping. A self-contained oiling system helps to simplify maintenance of the pump.

A mechanical seal may be used to replace the standard packing in the stuffing box.

**More information? Circle Item 32 on postcard, page 85.**

## Marine Steam Generator

A dry land adaptation of a marine steam generator that makes it possible to obtain 5000 lb of steam per hr from an overall floor area 8 x 7 ft has been designed by Cyclotherm Div., National-U. S. Radiator Corp., Oswego, N. Y.



Developed over a period of years to meet the specifications of the U. S. government, the boiler is 7 ft high and is designed to modulate over a wide range of operating conditions. It is completely electronically controlled.

An oil pump assembly is furnished factory-installed under the unit to save space and cut down installation cost. Water treatment tanks are mounted on the side of the boiler shell and piped to the feedwater pump system. Bypass piping permits manually controlled water circulation.

**More information? Circle Item 33 on postcard, page 85.**

## Curtain Wall Intake Louver

An outdoor air louver has been designed for curtain wall construction by Herman Nelson Unit Ventilator Products, American Air Filter Co., Inc., Louisville, Ky.

The device facilitates the installation of heating, ventilating, and cooling units in schools where curtain wall construction is employed. The louvers are available in either aluminum or steel.

The design of the louver is such that it can be adapted to any thickness of panel or *sandwich* wall, or with a wood frame wall. Another advantage, as applied to the company's unit ventilators, is the air seal provided on thin panel walls. This is possible through the use of a gasket on the inside of the louver collar which is factory-mounted to the unit ventilator. A 6-in. galvanized sleeve, cut to applicable depth on the job, and the louver itself, are installed at the job site.

Application and dimension drawings for the new louver assembly are published by the manufacturer.

**More information? Circle Item 34 on postcard, page 85.**

## Elementary School Bowl

A vitreous china flushometer bowl is available from Universal-Rundle Corp., New Castle, Pa., for elementary school installations.

A regular rim, siphon-jet bowl, the unit has a 13-in. high rim and is available in two styles: with a 1½-in. top spud inlet for flushometer use, or with a 2-in. top spud inlet so that it can be used with a wall hung tank.

The bowl has the same design and glaze as the company's other plumbing fixtures. The glazed surface is the result of a one-fire process and is completely fused to the fixture body. The elementary bowl is available in white or any of the company's six colors—rose pink, mist gray, verdant green, desert tan, jonquil yellow, or azure blue.

**More information? Circle Item 35 on postcard, page 85.**

## Duplex Water Chillers

Water chilling units, ranging in size from 800 to 1200 hp, are being made by The Trane Co., La Crosse. Wis., with twin compressors for air conditioning installations demanding high tonnage capacities. The compressors are located on the same side of a single, large evaporator and condenser.

The duplex units were designed and engineered so that the features of the company's single-compressor CenTra-Vacs could be retained. These include capacity control, hermetic operation, minimum noise and vibration, automatic operation, positive lubrication, gas-cooled motors, and load limit control.

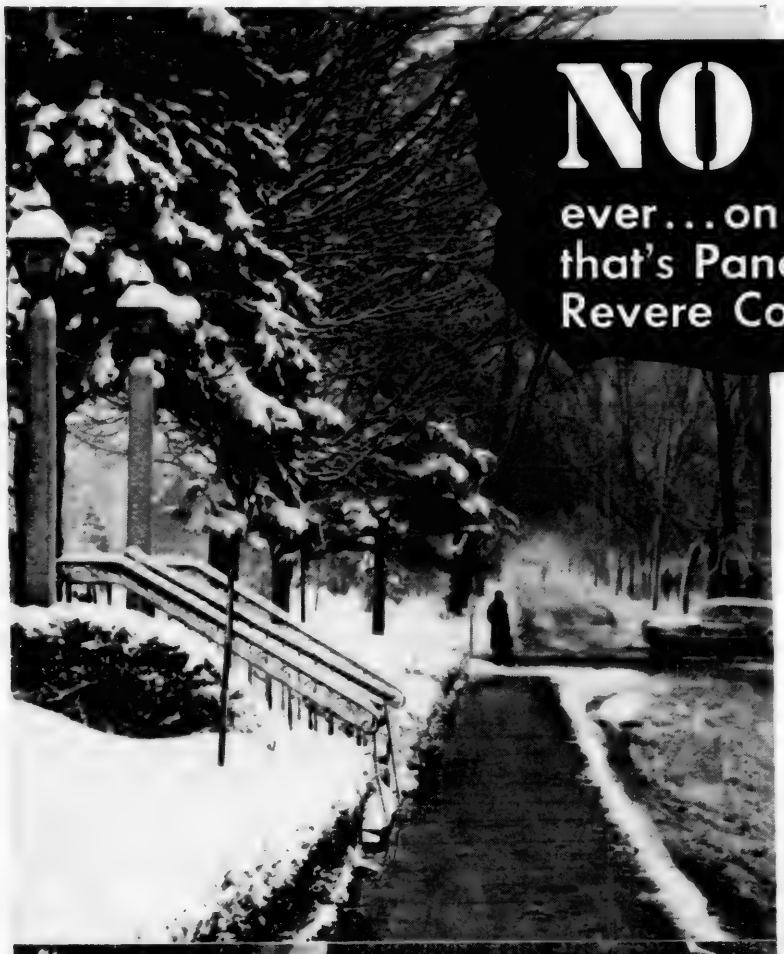
Other features of the duplex chillers are lower current demand at starting, and stand-by capacity. The lower inrush current demand during starting is possible because the unit's two motors are arranged to start in sequence. This is important in areas where power companies, or other conditions, impose limits on the maximum allowable inrush current for motor start-up.

The compressors operate in sequence and can perform singularly or together, depending on the refrigeration demand at a specific time. The fact that the two compressors can operate independently, permits most types of general maintenance to be performed on either, while the other continues to operate.

Information about general features applying to the units is contained in Bulletin DS-399.

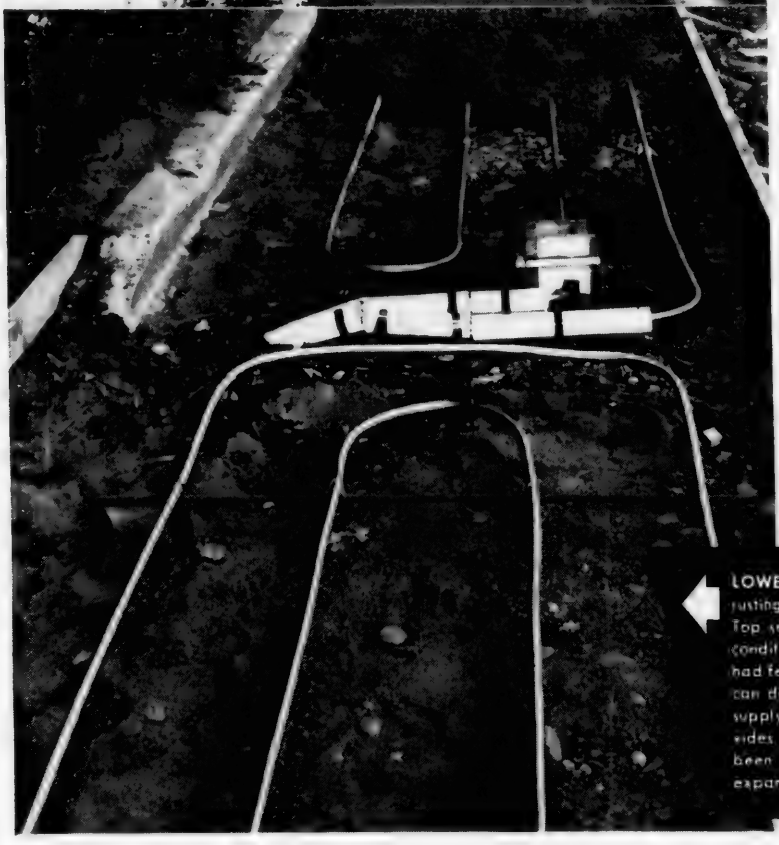
**More information? Circle Item 36 on postcard, page 85.**

(*Continued on page* 122)



# NO SNOW

## ever... on the sidewalk that's Panel Heated with Revere Copper Water Tube



Huge strides are being made by this method of snow removal. No wonder, shoveling and accidents due to snowy walks are eliminated . . . while the time and labor saved pays for the installation in short order.

That's why you'll find snow melting panels also being used on driveways, loading platforms, entrance aprons, service stations, pedestrian ramps at railroad stations, airports and similar spots. One application which bears special mention is the use of coils in garages. They quickly melt the snow on cars, keep floors dry as well as keep the repair shop floors warm so mechanics can lie right on the bare concrete in comfort.

And when you make the panels of Revere Copper Water Tube you have these added advantages: Copper can be bent to conform to the terrain. Bendability permits use of sinuous coils, while the 60-foot lengths of tube mean fewer fittings which, when joined by solder means joints that stay tight. Copper tube cannot rust, rot or deteriorate. That's why, on the inside, full flow and low frictional resistance are maintained throughout its long life. While external moisture will not harm it from the outside.

Keep ahead of the parade. Recommend Panel Heating for snow removal. Revere's Technical Advisory Service will be glad to help you in the proper application of Revere Copper Tube in working up your plans.

**FREE!** Instructive 16mm Full Color Motion Picture, "The ABC of Radiant Panel Heating." Write Advertising Department for details.

**REVERE**

**COPPER AND BRASS INCORPORATED**

*Founded by Paul Revere in 1801*

**230 Park Avenue, New York 17, N. Y.**

*Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N.Y.*
*Sales Offices in Principal Cities, Distributors Everywhere.*

**LOWER SECTION OF PHOTOGRAPH** shows how non-rusting Revere Copper Tube was imbedded in concrete slab. Top section of photo shows same walk under actual snow conditions. Note bends. Think of all the joints necessary had ferrous pipe been used. And think, too, of what seepage can do to rustable materials. Note insulation used on each supply and return line to the coils from the mains. This provides flexibility in the take-offs from the mains, which have been run below the slab, to allow for movement due to expansion and contraction.

(*Continued from page* 120)

## Welding Insert Rings

Inert-gas, tungsten-arc welding of piping without backing rings, smoother root pass welds with the elimination of root pass cracking, and improved weld contours in thin wall piping with one or two less passes, are some of the benefits claimed by a line of consumable, solid, insert rings available from Industrial Piping Div., Grinnell Co., Inc., Providence, R. I.

On piping of wall thickness over ¼ in., the welding insert ring assists in obtaining root-pass welds of uniform and smooth contours, free of crater and center-line cracks. The completed root pass weld provides a back-up for the subsequent shielded, metal-arc welding with covered electrodes.

On thin-wall piping, as Schedule 5 and 10 stainless steel, the welding insert ring improves the weld contour. On many sizes, the insert ring also eliminates the need for separately supplied filler metal and the necessity for one or two additional weld passes.

The consumable, solid, insert rings are produced for standard or special pipe and tube sizes of diameters 1½ in. or larger.

Insert ring materials commonly available are: mild steel; alloy steels 1¼ Cr-½ Mo, 2¼ Cr-1 Mo, 5 Cr-½ Mo; stainless steel Types 304, 304 ELC, 310, 316, 316 ELC, 347 (A) (fully austenitic), and 347 (F) (4-6% ferrite).

Technical information describing welding procedures is available upon request.

**More information? Circle Item 37 on postcard, page 85.**

## Dual System Conditioners

Dual systems are being featured by the Royal-Aire 10- and 15-ton, self-contained air conditioners made by Union Asbestos & Rubber Co., Heating and Cooling Div., Chicago, Ill.

Both models are designed for commercial, industrial, and institutional use. The packaged units are equipped with a pump-down control system, which insures that a minimum of gas remains at low pressure in the coils when the machine shuts down. They are also equipped with dual cooling coil circuits, controlled with separate thermostatic expansion valves.

Each unit has two accessible hermetic compressors and dual condenser circuits. The dual system gives the user control of both temperature and humidity. Under light load conditions only one system is operating, but in cases of extreme heat and high humidity both operate automatically.

Though equipped with a standard vertical fan discharge, the units can be provided with a horizontal, rear fan discharge for use with duct work, as optional equipment. Each can also be furnished, with a single, two-stage thermostat.

The two-tone, semi-gloss, baked enamel, grey finish is accentuated with gold trim above the double fluting on the front panel. Extruded aluminum, air foil louvers are installed in the discharge grille. The fresh air connections are on both the right and left sides. The entire case is lined with ½-in. insulation to provide thermal and acoustical insulating.

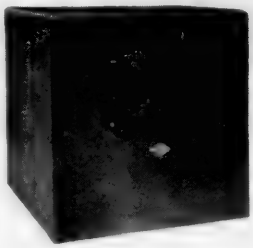
The controls are located behind a push-in nameplate at a level to eliminate stooping or bending.

**More information? Circle Item 38 on postcard, page 85.**

## Evaporative Cooler

A washer type evaporative cooler, named Polar Breez, is introduced by Air Cooling Engineering Co., Evanston, Ill.

Designated Model A-528, the unit has a cooling capacity equal to 15 tons of refrigeration. It has a built-in water recirculation system and requires 15 gal of water per day. For systems that already have a fresh air supply, the evaporative cooler is available as an add-on unit to provide cooling and filtering.



Powered by a 3-hp motor, the unit delivers 15,000 cfm. Units in sizes of 10,000 and 30,000 cfm are also available.

Made of 18-gage, rustproofed steel, the cabinet of the unit measures 60 in. high, 60 in. wide, and 72 in. long.

**More information? Circle Item 39 on postcard, page 85.**

## Small Fan Motors

Small fan motors with an increased service life have been developed by General Electric Co., Schenectady, N. Y., to meet the requirements for longer service life on applications such as domestic refrigerators, freezers, and refrigeration condensing units.

Available in output ratings from 1.5 to 16 watts, the shaded pole motors have an added service life due to a recently developed lubricant and greater oil retention capacity. This capacity is approximately three times that of the company's standard, 51-frame designs.

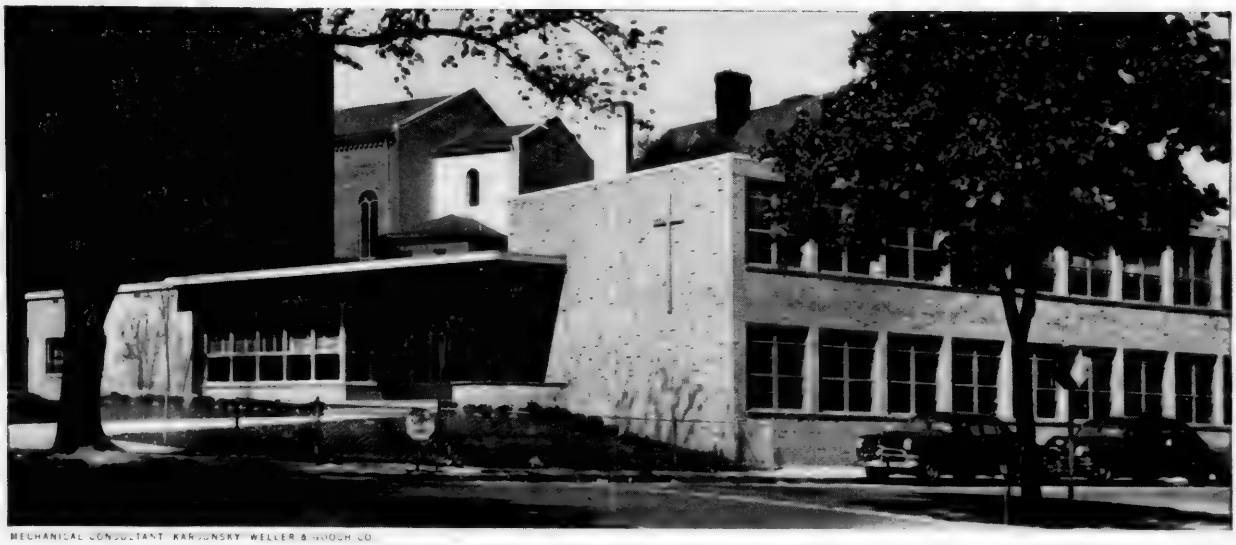
The oil has a projected oxidation life several times longer than that previously used. It is offered as an optional feature.

A pump on the shaft continuously recirculates cool, filtered oil from the storage wicks to the bearing surface. To help preserve oil stability, the oil path is kept away from the heated rotor.

Factory lubricated for the life of the units, the small fan motors have a diameter of 3½ in., with all outside dimensions remaining the same.

**More information? Circle Item 40 on postcard, page 85.**

(*Continued on page* 124)



MECHANICAL CONSULTANT: KARLOUNSKY, WELLER & HOUGH CO.

# Holy Redeemer School Installs and Insulates 115-Foot Steam Line with Gilsulate® in 24 Man-Hours

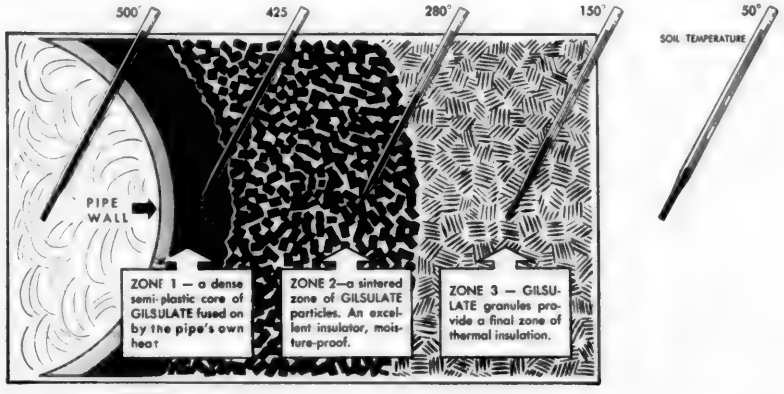
**LOW-COST INSTALLATION HAS LIFETIME PROTECTION AGAINST HEAT LOSS AND CORROSION**

Here's more proof that GILSULATE can save money for *you*—even on *small* as well as large jobs.

The Holy Redeemer School, Washington, D. C., recently installed 115 feet of 5-inch and 1¼-inch pipe for steam lines and return into their new 16-classroom building. Only 3 men were employed on the job. The installation was made in a trench 6 feet deep. The GILSULATE, after being wheeled to the top of the ditch, was skidded down and poured into forms around the pipes.

Total time for the *complete* job—including form construction, pouring 6½ tons of GILSULATE, and backfilling—was 24 man-hours. No other method for insulating and protecting hot underground pipes can match this performance—*Triple-Zone* GILSULATE *shows the lowest installed cost providing efficiency and permanence.*

Investigate the value of this easily installed, low-cost GILSULATE. Use the coupon below for complete information, or see your local GILSULATE distributor.


500°
425
280°
150°
50°
SOIL TEMPERATURE
PIPE WALL
ZONE 1 — a dense semi-plastic core of GILSULATE fused on by the pipe's own heat
ZONE 2—a sintered zone of GILSULATE particles. An excellent insulator, moisture-proof.
ZONE 3 — GILSULATE granules provide a final zone of thermal insulation.

## Facts about Gilsulate

1. *Easy to use*—just pour, tamp and backfill...pipe heat does the rest.
2. *Forms 3 zones* of protection against heat loss and all hazards commonly encountered by hot buried pipes.
3. *Needs no housing or mechanical sheaths:* no mixing, special handling or equipment.
4. *Only needs normal pipe spacing:* for multiple pipe or cramped conditions.
5. *Three types available:*
   Type A for 220°-310° F. temp. range
   Type B for 300°-385° F. temp. range
   Type C for 385°-520° F. temp. range

THE TRIPLE-ZONE INSULATION FOR LIFETIME PROTECTION OF HOT UNDERGROUND PIPES

GILSULATE®

AMERICAN GILSONITE COMPANY, SALT LAKE CITY 1, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California

American Gilsonite Co.
134-A West Broadway, Salt Lake City 1, Utah
or
1145 East Jersey St., Elizabeth, N. J.

*Send me more information on GILSULATE Insulation*

NAME.....

TITLE.....

COMPANY.....

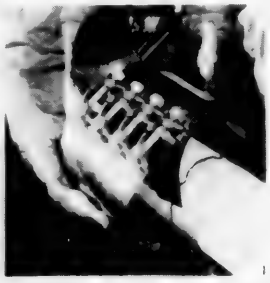
ADDRESS.....

AHV

(*Continued from page* 122)

## Clamp Repairs Pipe

A dual purpose repair clamp for water, gas, or oil pipelines is available from Smith-Blair, Inc., So. San Francisco, Calif. Its applications are for the repair of cracked or broken pipe and to connect two lengths of cast iron, steel, or asbestos-cement pipe in the trench.



The full circle clamp coupling has ball-and-socket, pivoting, iron lugs and free floating bolts. These features give the clamp increased holding power and make it possible to install the clamp on the pipe without interrupting service. The matching halves of the coupling are pre-assembled with a gridded gasket and an armored insert at the factory.

By opening one side of the clamp it can be dropped over the pipe. There are no loose parts. The metal bands are made of cold rolled copper or stainless steel and are furnished with silicon bronze or stainless steel bolts.

Each clamp coupling will fit a variety of types of pipe and is individually packaged at the factory in cartons labeled with the size and description of the clamp as well as the directions for its application in the field.

Pipe sizes are listed in a bulletin, Series 2F, from 2 to 24 in., nominal sizes.

**More information? Circle Item 41 on postcard, page 85.**

## Room and Unit Coolers

Two newly-designed lines of fan coil air conditioning units are announced by Carrier Corp., Syracuse, N. Y.

Using remote sources of refrigeration and heat and permitting individual zone control of temperature, in addition to dehumidification, air circulation, filtering, and ventilation, the units are suitable for motels, hotels, apartment houses, hospitals, office buildings, and residences.

Trade-named Room Weathermaker and Unit Weathermaker, the units are available in cooling capacities from ½ to 1½ tons and air handling capacities from 200 to 600 cfm. They may be employed in either a direct expansion system or chilled water circuit. No ductwork is required to bring cooled air from the central source.

The room air conditioners may be tied into water fed heating systems, replacing radiators to provide both cooling and heating in residential and commercial buildings. They may be recessed into the wall underneath a window (as illustrated) with the top serving as a window sill and the front flush with the wall, or they may be hung on the wall or mounted on legs. The same unit may be furred into the ceiling or suspended from the ceiling. Vertical or horizontal installations are possible because of an insulated L-shaped condensate pan.

Wall panels and discharge grilles are available which may double as window sills for furred-in applications or wrap-around cabinets for partially recessed or in-the-space installations. Fabricated of 18-gage steel, the panels, grilles, and cabinets are given a prime coating of sand grey paint, ready for finishing with any desired color.

The temperature control knob may be located at either end of the unit, and a damper attachment is available as an accesory for ventilation between seasons or for regulation of the outside air supply at any period.

The unit air conditioners are adaptable for installation high on the wall, behind a false ceiling or wall, in the top of a closet, or over an entrance with the unit supplying air directly into the conditioned space. Ductwork may also be used wherever needed.

**More information? Circle Item 42 on postcard, page 85.**

## Redesigned Room Heater

A new design called Flexitemp has been adopted by Reznor Mfg. Co., Mercer, Pa., for its gas-fired, floor model, room heater.

The unit's fan is now controlled by a temperature-sensitive, automatic, speed selecter which operates independently of burner controls. During mild weather when the burners operate with short *on* cycles the fan will operate at low speed. During severe weather when the time modulating thermostat calls for longer operating cycles, the fan comes on at low speed, shifts to high when the temperature in the heat exchanger reaches a preset point, then drops back to low before going off after the burners shut down and the heat exchanger begins to cool.

All controls are located in one grouping inside the cabinet. A snap-out door on one side gives access to the control manifold which can be removed as a single unit by breaking one union and removing the retaining screws. All controls can be removed for service without breaking electrical connections. Fan and limit controls in the front of the heater are reached by tilting the top louver panel.

In addition to the enclosed controls, the fan motor is mounted directly to the wire fan guard.

Features of earlier room heater models which have been retained in the new heater include: a wall thermostat, a winter and summer switch for hot weather operation of the fan alone, individually adjustable vertical and horizontal louvers, a built-in draft diverter, a steel cabinet finished in grey-green Perlite baked enamel, and conservative cabinet styling.

The room heater is designed for residential heating requirements as the basic, supplemental, or stand-by heating system and for a variety of commercial and industrial installations such as offices, shops, and show rooms. It is often used to supplement installations of suspended gas unit heaters.

**More information? Circle Item 43 on postcard, page 85.**

(*Continued on page* 126)

# Pennsylvania R.R. saves $500,000 a year burning coal the modern way

Power was a problem at Pennsylvania R. R.'s Juniata shops, part of its great Altoona Works. Low steam pressure was creating costly production delays; electric power failures meant additional delays; obsolete fueling methods resulted in troublesome flyash emission and other problems.

So Pennsy engineers consulted with Gibbs & Hill, Inc.—designers and constructors for the project—and modernized the power plant. Today three 60,000-lb.-per-hr. 600 psi coal-fired boilers supply steam to the shop area at 150 psi after it has driven two 1,500-kw turbine-generators. Between an adequate steam supply and reliable by-product electrical services, production delays have been eliminated. Air pollution is a thing of the past. Modernization of fuel handling has cut manpower costs. And today efficient operation plus lower fuel costs save Pennsylvania Railroad a half million dollars a year!

*For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.*

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D. C.

## Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

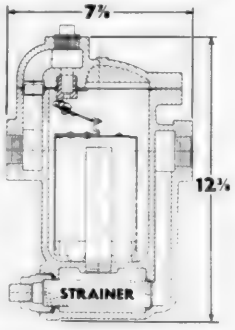
## *facts* you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

(*Continued from page* 124)

## Large Trap Is Added to Line

The largest model of four cast, semi-steel, integral strainer, steam traps manufactured by Armstrong Machine Works, Three Rivers, Mich., is announced as No. 883. The integral strainer protects the trap from harmful sediment, scale or other foreign particles that may be present in steam lines.




For use at pressures to 250 psig, the trap has a capacity for 3500 to 4400 lb per hr of condensate. The side inlet and side outlet, screwed pipe connections furnished are either ¾- or 1-in. Standard screen material is stainless steel, perforated with 0.045-in. diameter holes, 226 per sq in. Other screen materials are also available.

The integral mechanism of the trap is stainless steel with a lapped valve and seat of hardened chrome steel. The materials, workmanship, and design of the internal mechanism are identical to the mechanisms in the company's high pressure forged steel traps used for service up to 900 lb and 900 deg F.

A data sheet on the steam trap is available.

**More information? Circle Item 44 on postcard, page 85.**

## Line Of Fans

A variety of window fans, a low-table fan, and a roll-about air circulator are featured in the Active Air line of comfort cooling fans for home and office produced by Emerson-Electric Mfg. Co., St. Louis, Mo.

The window fans for the coming season include 16- and 20-in. electrically reversible models, with exhaust ratings of 2000 and 3200 cfm, respectively; a 20-in. manually reversible window and utility model with a rating of 3000 cfm; and 24- and 30-in. belt-driven models, available in reversible and non-reversible units. The belt-driven fans have a rating of 5000 and 6700 cfm in the reversible models and 5000 and 6500 cfm in the non-reversibles. All of the window fans are equipped with two-speed motors. All carry the company's 5-year, factory-to-user guarantee.

The three direct-driven window models have enclosures 7½ in. deep. The reversible models are suitable for mounting in windows with a minimum opening of 16 in. wide and 18 in. high for the 16-in. fan, and 20 in. wide and 22 in. high for the 20-in. fan. Mounting panels supplied with the fan permit adjustments for windows from 29⅛ to 36 in. in width. Mounting chains are supplied for installation in openings smaller than 29⅛ in. and larger than 36 in. in width. The 20-in. window and utility model is furnished with a mounting panel for installation in windows 29¼ to 38 in. in width between window stops.

The 24- and 30-in. belt-driven window fans are designed for installation in either the lower or upper portion of double hung windows and are furnished with mounting accessories.

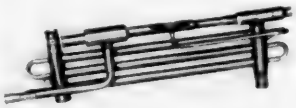
The low-table fan is equipped with a three-speed rotary switch, 12-in. overlapping blades, and delivers air at 3200 cfm. It stands 14⅝ in. high and is 15 in. in diameter.

Suitable for industrial plants, offices, stores, homes, and to exhaust air from a room with casement windows, the 18-in., roll-about air circulator can be tilted to any position in a 180-deg arc. Its height is adjustable from 28 to 48 in., and its stand is equipped with two rubber-tired wheels. The roll-about has a two-speed motor and delivers 3350 cfm.

**More information? Circle Item 45 on postcard, page 85.**

## Pressure Stabilizers

A series of pressure stabilizers has been designed by Bush Mfg. Co., West Hartford, Conn., to automatically maintain satisfactory head pressure on air conditioning and refrigeration systems where evaporative or air-cooled condensers are required to operate in low ambient temperatures. They can also be applied on systems using cooling towers where water regulating valves are not used.



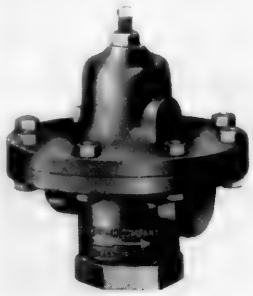
Called PS, the new unit maintains required head pressure, insures proper expansion valve operation, and maintains general system balance under such conditions.

The pressure stabilizer is equipped with a heat transfer mechanism which transfers heat from the hot gas discharge of the compressor to the sub-cooled liquid leaving the condenser when the pressure drop across the regulating valve is sufficient to cause liquid to pass through the heat transfer section. The unit is designed with a predetermined pressure drop to prevent the liquid refrigerant from reheating during warm weather.

**More information? Circle Item 46 on postcard, page 85.**

## Valve Is Revised

An improved version of the Cash Standard, Type D, pressure reducing and regulating valve for liquids, steam, and gases is introduced by A. W. Cash Co., Decatur, Ill.



Improvements to the valve include a 50% reduction in the number of flange bolts to save maintenance time, and a gasket seal at the diaphragm flange to facilitate pressure range conversion.

Features retained from the former model include: an interchangeable, internal working unit; an accessible interior; and a built-in strainer.

The valve is available with an iron, bronze, steel, or stainless steel body, and bronze, stainless steel, nitralloy or Monel trim. Screwed ends are available from ¼- to 2-in. in size.

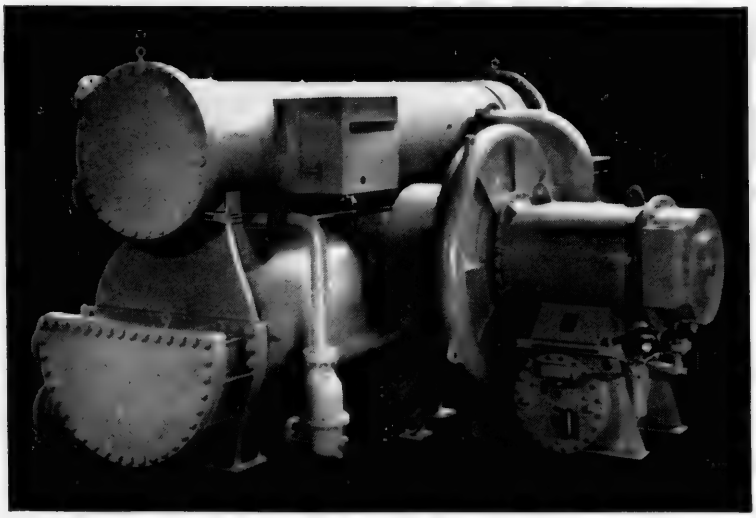
Complete information on the valve is contained in Bulletin 950.

**More information? Circle Item 47 on postcard, page 85.**

(*Continued on page* 128)

Cuts cooling, installation, and maintenance costs!

# SINGLE-STAGE TONRAC® INSTALLS ON ONE LEVEL

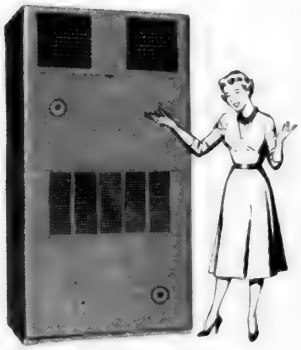


American Blower Tonrac automatically maintains chilled-water temperature, *regardless of load!* Requires no built-up bases.

An advanced-design, hermetic centrifugal refrigerating machine – Tonrac comes complete, ready for installation on *one* level. No build-up bases, flexible couplings, or speed-increasing gears are needed: The single impeller is directly driven by a constant-speed 3600 rpm motor. Saves weight, space, installation costs!

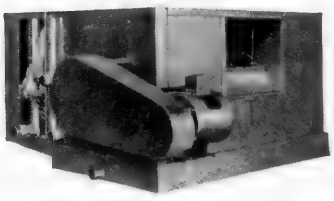
Tonrac cuts operating and maintenance costs, too, for it achieves compression in *one* stage . . . allowing two-bearing construction, and eliminating compression losses and power waste that are common with multi-stage units. This single-stage, hermetic design – with its inherent simplicity and few moving parts – assures quieter operation: makes even the roof an ideal location for Tonrac!

For full facts, call our nearby representative. Or write direct for Bulletin 1426.

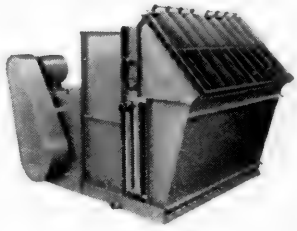


Packaged Air Conditioners for offices, stores, industrial plants, and similar applications. Cools without chilling. 3- thru 20-ton capacities.

## American Blower equipment answers all your air conditioning needs



**Central-Station Air Conditioners**



**Multi-Zone Air Conditioners**

American Blower offers a complete product line, designed and engineered to meet the exact specifications of your air conditioning requirements. Call on us, today, and pinpoint equipment responsibility for your entire system!

**American Blower products serve industry**

- Air Conditioning, Heating, Ventilating Equipment
- Mechanical Draft Fans
- Industrial Fans and Blowers
- Centrifugal Compressors
- Gyrol Fluid Drives
- Dust Collectors
- Refrigerating Machines

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American-Standard

**AMERICAN BLOWER**

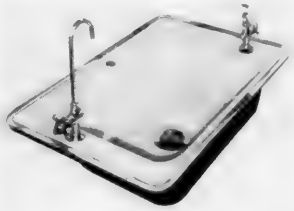
*Air conditioning equipment for every business*

(*Continued from page* 126)

## Counter Type Fountain

A counter type drinking fountain has been designed for use in schools and institutions by Bradley Washfountain Co., Milwaukee, Wis., to provide a sanitary source of water for drinking as well as for other facilities.

The fountain consists of a bowl, a stainless steel mounting rim, a drinking bubbler, a glass filler faucet, and a chromium-plated sink strainer with a tail piece. It is also available without the glass filler faucet.



The measurements of the unit are: 16 x 24 in. outside, with a 3¾-in. ledge at the back, 3¼-in. on both sides, and 1¼-in at the front, with a 6-in. depth of bowl.

Made of pressed steel, the bowl of the fountain is available in either acid-resisting vitreous enamel or in stainless steel. The enameled bowls can be furnished in white, forest green, sun tan, sea green, sky blue, and citron yellow.

A 28-page catalog is issued by the company describing its entire line of fountains and showers.

**More information? Circle Item 48 on postcard, page 85.**

## Portable Lift Telescopes

A 112-in., telescoping, portable lift for raising and lowering loads is introduced by The Oster Mfg. Co., Cleveland, Ohio.

Though designed for high stacking operations, the lift has a collapsed height low enough for handling loads in elevators, under balconies, and in other low head room areas. The new model, designated as L1112-P, has a 1000-lb lifting capacity and a battery-powered hydraulic lift.

Operated by one man, the lift can be used as a platform truck, a straddle fork truck, a portable elevator, or a shop crane. Its specifications are: Lift height—minimum 2 in. to maximum 112 in.; load center—15 in.; power rate—no load 33½ fpm, loaded 21½ fpm; required under clearance height—6½ in., width—20 in.; straddle capacity—30 in.; turning radius—60 in.; platform dimensions—28 x 28 in.; overall height (collapsed)—78¼ in.; overall width—37 in.; overall length—52 in.; net weight—986 lb.

**More information? Circle Item 49 on postcard, page 85.**

## Continuous Pressure Gage

An instrument capable of giving continuous readings of pressure under prolonged exposure to high temperatures and radiation has been developed by Callery Chemical Co., Pittsburgh, Pa.

Designated Model C, the pressure gage is available in standard and special pressure ranges. It operates on alternating current from 60 to 400 cycles in continuous radiation flux of one million Roentgens per hour. The gage may be installed on a pipe or vessel for use with high temperature liquids or gases. Its application is not limited to any specific liquids or gases inasmuch as the pressure-sensing bellows may be manufactured from a variety of resistant materials with its scope of usefulness increasing accordingly.

The instrument consists of a bellows, a differential transformer, and a meter to indicate variations in the transformer output. The bellows and transformer constitute one unit connected by cable to the receiver which may include either a direct-reading or a recording meter.

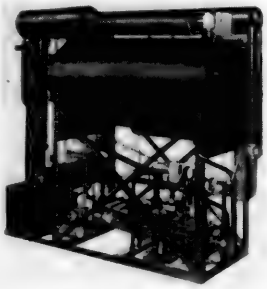
The gage operates by measuring the change in electrical output in the secondary of the differential transformer caused by movement of the core. The core is connected by a direct linkage to the bellows. Any change in pressure on the bellows causes a directly proportional movement of the core, which, in turn, induces a variation in the electrical output of the transformer. The gage is not sensitive to temperature.

Since many applications of this type of gage are in systems where leaks are detrimental, the bellows, located immediately below the transformer, serves as a secondary seal. When the instrument is used in systems containing material with a relatively high melting point, an additional safeguard against leaks is provided by solidification of the material in the housing of the linkage.

**More information? Circle Item 50 on postcard, page 85.**

## Absorption Water Chiller

A 25-ton, absorption-type water chiller which incorporates its own factory-assembled operating and safety controls is offered by Servel, Inc., Evansville, Ind.



Three connections—to water, steam, and electricity—are required to put the chiller into operation. The controls are designed for the unit and installed at the factory.

The cooling capacity of the packaged chiller is modulated to meet any need up to the full 25 tons. It may be reduced to as low as 50% of rating with a corresponding reduction in steam consumption. The unit utilizes steam pressure—from any source—between 6 and 15 lb. It is an absorption refrigeration unit which may be installed in single or multiple to provide chilled water for heavy-duty air conditioning and industrial processing applications.

Among the uses for the chiller are: temperature and humidity control in textile mills, sugar refineries and printing plants; process cooling in canning factories and bottling plants; removing heat of chemical reactions in anodizing and electroplating operations; dissipating heat of process machines in various industries; and air conditioning in large homes, offices, motels, apartment houses and hospitals.

**More information? Circle Item 51 on postcard, page 85.**

(*Continued on page* 130)

# Sarco Condensate and Vacuum Pumps give you this big advantage...

**UNDIVIDED RESPONSIBILITY**
**by Sarco for pumps as well as heating specialties!**

Now Sarco expands its extensive heating line... by adding *condensate and vacuum pumps*... offering you in still larger measure the protection and convenience of *undivided responsibility*.

Shown above is one of the many Sarco pumps... it's the streamlined Sarco type S condensate pump. Designed and built to Sarco's traditionally high quality standards, it assures you top performance and long, trouble-free life. The many advantages include:

...Low 7½" inlet... Close coupling... No sub-base needed. Inspection? Just unscrew 3 nuts and lift the motor; no need to disconnect the piping. For a complete list of features, mail the coupon today.

**Selection** — The experienced Sarco-Sarcotherm engineering staff will gladly help you select the right Sarco condensate or vacuum pump for each job.

**Undivided Responsibility** — From *one* reliable "Complete Line" source... SARCO-SARCOTHERM ...get not only condensate and vacuum pumps but also heating specialties, steam traps, temperature regulators, finned-tube radiation, and weather-compensated control systems for steam and hot water heating.

**SARCO—SARCOTHERM**

*MAIL COUPON FOR THESE BULLETINS*

**Sarco Company, Inc.**
**Sarcotherm Controls, Inc.**
**Empire State Bldg., New York 1, N. Y.**

Please send me:

☐ Bulletin on New Sarco type S Condensate Pumps.

☐ Bulletin on all Sarco Vacuum and Condensate Pumps.

Name_____

Firm_____

Address_____

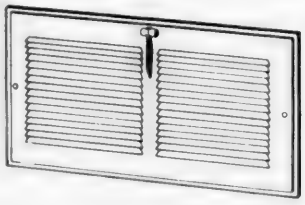
City_____ State_____

2158-B

(*Continued from page* 128)

## Registers and Grilles

A line of registers and grilles for heating and air conditioning is being manufactured by Kalamazoo Furnace and Appliance Mfg. Co., Kalamazoo, Mich. The line has been designed to save time and inventory space.



One unit in the line is applicable for two operations. With the introduction of an E-frame it is possible to transform the sidewall unit (illustrated) into a baseboard installation.

Each register and grille is finished in natural beige. They can be painted to match the decor of the room in which they are installed.

The hot air registers vary in size from 8 x 4 in. to 14 x 6 in. The cold air intake grilles are sized from 8 x 4 in. to 30 x 8 in., and the baseboard frames from 8 x 6 in. to 14 x 6 in. Most of the registers and grilles come with standard horizontal fins; vertical fins are optional.

The company also manufactures baseboard gravity registers and return air intakes as part of the register and grille line.

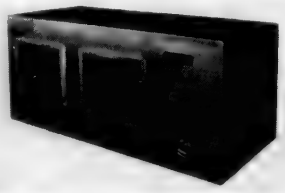
Additional information, prices, and general data are published by the company.

**More information? Circle Item 52 on postcard, page 85.**

## 5-Ton Air Conditioners

Five-ton, air-cooled, summer air conditioners, to be used in commercial and large residential applications, have been put into production by Armstrong Furnace Co., Columbus, Ohio. The new unit is constructed so that the dealer has the least possible difficulty in installing it. As with the 2- and 3-ton units, the 5-ton condensing unit (illustrated), in its aluminized steel cabinet, is installed outside the building.

Both the evaporators and condensing units are shipped assembled. The condensing unit carries a complete charge of liquid refrigerant. The blowers in the condenser, there are two, are 13 in. wide. With their ⅓-hp motors, they are capable of delivering 5000 cfm across the condenser coil. The unit is being offered in 230-v, single phase and 208-220-v, three phase. Both the single and three phase units have double overload protection for the compressor.



The only electrical connections the installing dealer must make outside the building are the power leads to the compressor contactor and the low voltage wires to the compressor contactor solenoid. Inside the building only the evaporator blower and the thermostat have to be connected. All other wiring is done at the factory.

At the present time R5, R8, and R9 evaporator sections are available. The R5 is the vertical independent evaporator containing its own 13-in. squirrel cage blower. It may be installed upright beside the basement furnace and, with minor duct changes, may use the same air distribution system. The R9 horizontal independent evaporator unit is useful as a suspended space cooler where there is no central heating system or where warm air heating is not being used.

The R8 is a horizontal flow evaporator unit for use with a forced air heating system. It must be installed in the plenum before any distribution pipes are taken off. It is suitable for use with a horizontal furnace, although it may be installed with other models as well.

The filters and blower of the furnace must be used with the R8, but these are part of the R5 and R9. Both have as standard equipment 13-in. squirrel cage blowers with ½-hp motors, which will deliver 2000 cfm through their filters.

**More information? Circle Item 53 on postcard, page 85.**

## Straight-or-Angle Valve

A two-way, flow control valve which is adaptable to either straight or angle installations is announced by Bell & Gossett Co., Morton Grove, Ill. The valve is used to prevent gravity circulation in a forced hot water heating system when the booster pump is not in operation.

Designed to reduce the amount of inventory needed for this type of valve, the new pattern, designated SA, is available in 1, 1¼, and 1½-in. sizes. It replaces the individual straight or angle pattern valves of the same size.

An arrow is cast onto the body of the valve to indicate the direction of flow for straight or angle installations. The arrow serves as a guide to the installer. A plug is installed in the unused opening.

**More information? Circle Item 54 on postcard, page 85.**

## Masonry Drills

Eleven tungsten, carbide-tipped masonry drills are added to the Proto line by Plomb Tool Co., Los Angeles, Calif. They are designed for high-speed drilling through concrete, brick, marble, granite, stone, tile, plaster, asphalt, plastics, asbestos, wallboard, glass, reinforcing steel, and steel beams embedded in masonry.

The drills are turned by rotary electric and air drills. They are used principally by masonry workers, builders, contractors, plumbers, electricians, shop repairmen, miners, and home craftsmen.

Six of the eleven drills, for 3/16 to ½-in. holes, are the solid cutter type. They have no dead center and, therefore, operate with only a modest pressure.

Five drills, for ⅜ to 1⅛-in. holes, are the hollow core type. They have three or more cutters, which drill the outside ring, leaving a removable core. Multiple spirals speed the work by removing dust.

**More information? Circle Item 55 on postcard, page 85.**

(*Continued on page* 132)

# DEPENDABILITY

## *the one thing in heating you dare not overlook*

### Petro rotary oil burners are dependable because of their simple design and sound, rugged construction

Sluggish heavy oil (No. 6) is easily controlled by a system that is remarkably free from mechanical "gimmicks." It's like this:

1. A simple oil heater automatically warms the oil to a point where viscosity is constant. (See chart.)
2. A magnetic valve passes the oil to the nozzle when it is warm enough for accurate metering and instant ignition.

That is the basic idea of the Petro Thermal Viscosity Principle. It isn't fancy; it isn't temperamental: but it STAYS ON THE JOB. Petro owners need not be impressed by metering pumps, viscosity compensating valves, or other complicated mechanisms found in many burners.

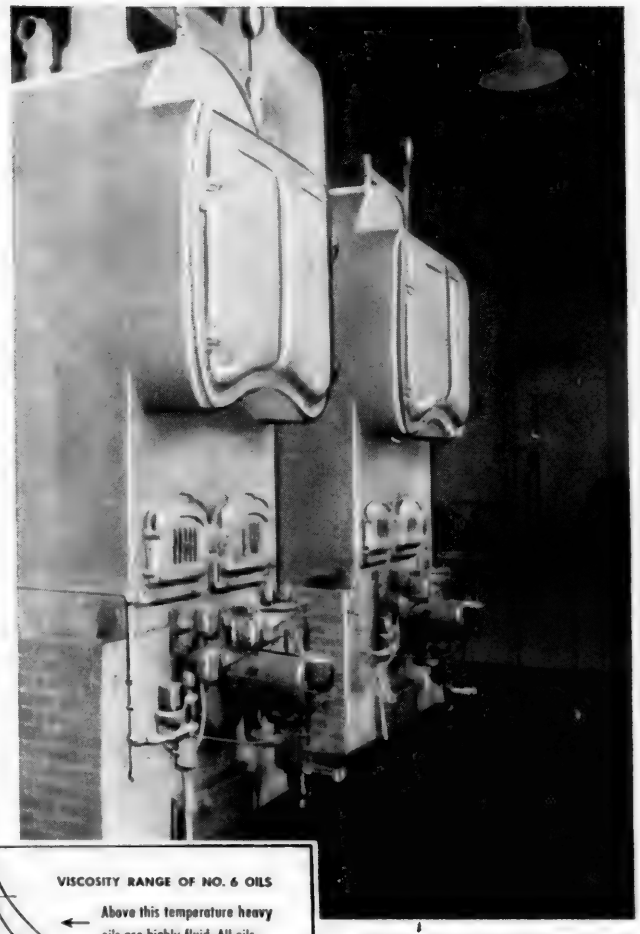
### All this and fuel economy too

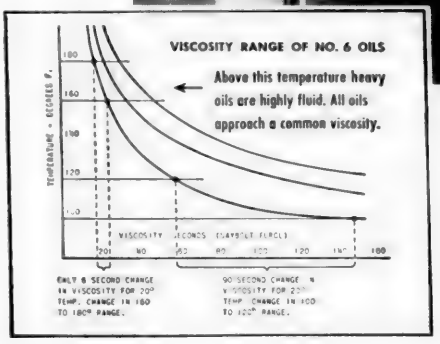
Petro oil burners have been the steady, reliable work horses in heavy oil firing for over 50 years. They have saved their owners untold thousands of dollars by efficient firing of the viscous industrial oils, which cost less per gallon, and are richer in heat value than the light oils.

### Gas-oil models also available

The ability to switch fuels at a moment's notice protects against fuel emergencies and cuts fuel costs. Any Petro rotary oil burner (including those now in use) can be readily combined with the Petro gas burner, providing a dual-fuel firing system in a single integrated unit.

For further information use the accompanying coupon, or look in the yellow telephone directory pages under Oil Burners for name of your Petro dealer.






Heating plant in the Midvale School, Madison, Wis. The two Petro rotary oil burners are equipped for automatic modulating flame control.

**PETRO**

T. M. REG. U. S. PAT. OFF.

**OVER 50 YEARS OF LEADERSHIP IN AUTOMATIC HEATING AND POWER EQUIPMENT**

PETRO
3222 West 106th Street, Cleveland 11, Ohio.
(In Canada: 2231 Bloor Street W., Toronto, Ontario.)

Please send me literature and specification sheets on money-saving Petro commercial and industrial burners.

Name_____

Company _____

Address_____

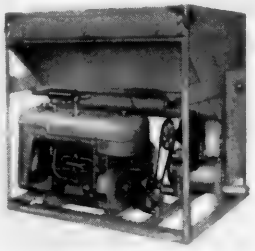
City_____ State_____

(*Continued from page* 130)

## Insulation Blowing Machine

An automatic insulation blowing machine, which blows mineral wool and many other types of insulating material, is introduced by The Universal Insulating Machine Co., Van Wert, Ohio.

Named the Ultra-Matic, the machine can be controlled by the hose man through a remotely controlled, magnetic disc-type, electric clutch. Another feature of the machine is a straight gravity feed through the shredder to the feeder which prevents material from bridging in the hopper or plugging the shredder.



To meet the requirements of various types of jobs, the machine has eight different feeding speeds, which are controlled by an eight-position sliding baffle between the shredder and feeder. This baffle makes it possible to cut off the feeder completely for blowing out and cleaning the hose. Shear keys that can be replaced in 30 to 60 seconds protect the feeder and hopper agitator from damage.

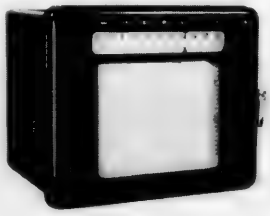
There are four models of the blowing machine: the IH-47, with a 17-hp, water-cooled engine and a 2½-in. blower; the IH-59, with a 17-hp, water-cooled engine and a 3 in. blower; the W-47, with a 15-hp, air-cooled engine and a 2½-in. blower; and the W-59, with a 15-hp, air-cooled engine and a 3-in. blower.

**More information? Circle Item 56 on postcard, page 85.**

## Potentiometer Recorder

An electronic potentiometer-recorder of the null-balancing type has been developed by Wheelco Instruments Div., Barber-Colman Co., Rockford, Ill. The unit is completely self-contained and requires only an external sensing device.

Designated Series 8000, the recorder is available in a range of models which measure, indicate, control, and give a permanent record of such variables as temperature, speed, strain, hydrogen ion (pH), and other quantities that can be resolved into electrical signals. Most important applications of the instrument are: (1) for measurement and control of temperatures in the pyrometric range; (2) as a resistance thermometer-type of system; (3) to measure speed; (4) as a radiation receiver (pyrometer); (5) for any function which can be resolved to a d-c signal load and the measurement of pressures through the use of a strain gage (primary element).



Access and adjustments to the instrument are permitted by an outer door that swings open 180 deg to permit close examination of the chart. Both the chart rolls and the chart and recorder drive assembly swing out 180 deg in the opposite direction by means of a two-way operating knob. The calibrated slide wire remains in positive contact at all times.

The instrument is available in a selection of standard scale ranges which can be changed without a soldering iron or the necessity to change the slide wire. The amplifier chassis uses plug-in components with standard electronic tubes.

**More information? Circle Item 57 on postcard, page 85.**

## Anti-Vibration Fastener

A rubber bushing in one end of which is bonded a threaded hex brass nut, the opposite end being provided with a flange, is being produced by Rockwell Products Corp., Newark, N. J.

Called Well-Nut, the fasteners will give an airtight and watertight seal and will hold where panels are too thin to be tapped to take a screw. They are suitable for making attachments to porcelain, thin plastics, glass, laminated wood, sheet metal, insulation board, or any composition material for which normal methods are unsuitable. Due to their rubber exterior they will not damage or chip porcelain or other similar materials.

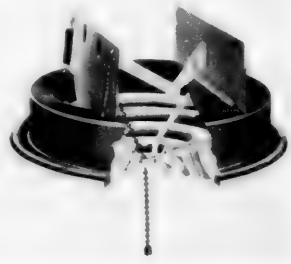
The nuts can be assembled from one side as it is not necessary to have rear access. They come in a range of diameters from 5/16 to ½ in.—thread sizes 6/32, 10/32, and ¼.

**More information? Circle Item 58 on postcard, page 85.**

## Round Ceiling Diffuser

A round, step-down type, ceiling diffuser for heating and cooling is being manufactured by The Lima Register Co., Lima, Ohio.

Designated Series 65, the unit has curved contour, step-down rings without straight edges. This provides maximum free area and efficient distribution of supply air in all directions at an angle to eliminate ceiling streaks and induce recirculation of room air. It is available in seven sizes from 6 to 22 in. in diameter.



The diffuser's damper assembly has built-in, spring-loaded, butterfly dampers which provide full center opening for air delivery through the center of the diffuser, and full shutoff. The volume control is in the damper assembly for balancing a system. When the damper is not used, a ring is available to facilitate installation.

Like the company's square ceiling diffuser, the round ceiling diffuser has a permanent light beige finish to harmonize with modern ceilings; it does not require repainting. A sponge rubber gasket provides a seal against air leaks.

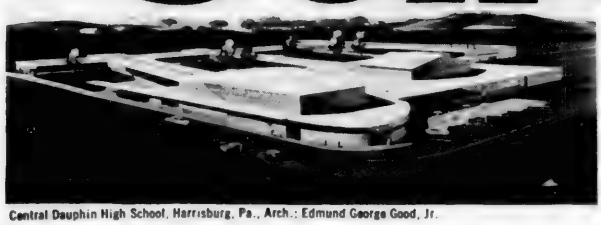
**More information? Circle Item 59 on postcard, page 85.**

(*Continued on page* 134)

Mill Road School, N. Merrick, L. I., N. Y., Arch.: Frederic P. Wiedersum

Cornelius Street School, E. Hempstead, L. I., N.Y., Arch.: Frederic P. Wiedersum

# schools



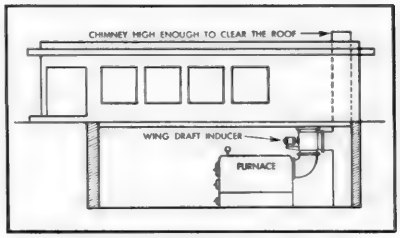
Central Dauphin High School, Harrisburg, Pa., Arch.: Edmund George Good, Jr.

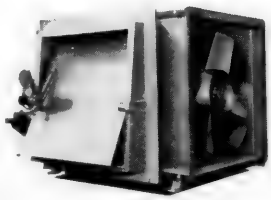
Grace Wilday School, Roselle, N. J., Arch.: Ernest T. Brown

## . . . modern schools use draft inducers — not tall chimneys.

Induced draft is the outstanding development in modern heating boiler operation. There is no longer need for tall unsightly chimneys. Wing motorized Draft Inducers easily solve the draft requirements. The only chimney needed is a stub stack to vent exhaust gases. Architects find this fits admirably into modern, low, functional school designs where the outmoded tall chimney would be impossible from an esthetic standpoint. Other advantages are lower fuel costs, lower capital costs, and, of course, positive adequate uniform draft regardless of wind or weather.

In confirmation of the above, there are over 1000 Wing Draft Inducer installations in schools alone, in all parts of the country, burning oil, gas or solid fuels. Hundreds more are being specified by architects and engineers as the unprecedented school program continues. Write today for a copy of Bulletin I-56 and special Schools Bulletin SCH-1.



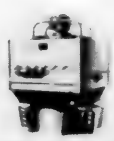



# Wing

## DRAFT INDUCERS

**L. J. Wing Mfg. Co.** 158 Vreeland Mills Road, Linden, N. J.
Factories: Linden, N. J. and Montreal, Canada

WING REVOLVING HEATERS



WING FRESH AIR SUPPLY HEATERS

WING BLOWERS

WING TURBINES

*Write for bulletins. Use the coupon.*

L. J. Wing Mfg. Co. AC-5
158 Vreeland Mills Rd., Linden, N. J.

Please send copy of Draft Inducer Bulletin I-56 and Schools Bulletin SCH-1.

Name.....

Firm.....

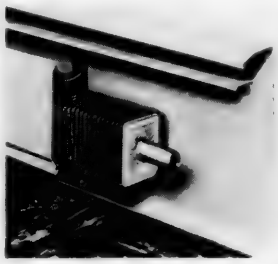
Address.....

City..... Zone..... State.....

(*Continued from page* 132)

## Baseboard Radiators

A line of baseboard radiators for hot water, perimeter heating is announced by Fedders-Quigan Corp., Trenton, N. J.



Designated Model L, the radiator is fabricated of copper tube with aluminum fins spaced 48 per ft. The fins, mechanically bonded to the tube, are corrugated for strength, and the mounting holes are equipped with flanged collars for larger area contact with the tube. Through mandril expansion, the tubing is expanded at the fin junctures to make a tight fit for efficient heat transfer.

More information? Circle Item 60 on postcard, page 85.

## Flush Stud Fasteners

Three studs, designed to perform construction or maintenance fastening jobs where stud heads should be comparatively flush with the surface, are introduced by Remington Arms Co., Inc., Bridgeport, Conn., for use with powder-actuated tools.

The studs have flat heads, are $\frac{3}{8}$ in. in diameter and $\frac{1}{8}$ in. thick, and have thin shanks. When used in the company's Model 455 stud driver, no extra washer or disc under the stud head is required. The studs can be driven with 22-caliber power loads.

One stud is $1\frac{3}{8}$ in. long and is used to fasten metal lath, metal ducts, and other light sheet metal to concrete, as well as masonry ties to concrete or blocks. Another stud, $2\frac{1}{8}$ in. long, is suitable for furring strips to concrete or blocks. The third stud is $3\frac{1}{8}$ in. long and is designed to fasten wooden two-by-four's to concrete and for shoring and form work.

Users equipped with the Model 455 stud driver with a $\frac{1}{4}$-in. barrel can adjust the tool for the new studs, as well as a full line of heavy duty studs, with a $\frac{3}{8}$-in. barrel conversion kit. The stud driver can be converted from a $\frac{1}{4}$-in. stud capacity to $\frac{3}{8}$-in. on the job.

More information? Circle Item 61 on postcard, page 85.

## Cooling Capacity Booster

A spined tube for increasing the capacity of refrigeration and air conditioning systems has been developed by Heatron, Inc., York, Pa.

Named Thermek, the device has an inner tube, to which the liquid line is connected, that has been machined around and along its outer surface to produce a closely packed array of spines, which serve as a heat transfer surface. The spines remain attached to the tube and are an integral part of the parent metal.

The device takes the place of the usual drier loop. By sub-cooling the liquid, the compressor is made more effective, and the likelihood of excessive flash gas being generated is reduced. Among the advantages claimed for the device are: increased capacity of the expansion valve; more of the evaporator surface is utilized; suction line sweating is reduced or stopped; smoother valve operation; overall system capacity is increased.

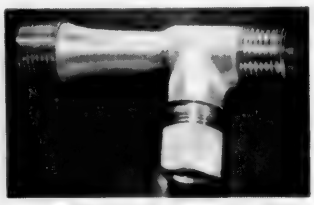
By installing the booster as a water-cooled condenser, extra cooling may be added to air-cooled systems.

Shell diameters (outer shell) range from $1\frac{3}{8}$ to $2\frac{1}{8}$ in.; overall lengths from 12 to 27 in. Liquid line connections may be $\frac{1}{4}$, $\frac{3}{8}$, or $\frac{1}{2}$ in.; suction line connections $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$ or $\frac{7}{8}$ in.

More information? Circle Item 62 on postcard, page 85.

## Liquid Ejector

An ejector for pumping, mixing, or aerating liquids is being marketed at competitive quantity prices by The Bruner Corp., Milwaukee, Wis.



Available in four stock capacities, the ejector is constructed with a forged brass body and a removable brass nozzle. The operating flow rates of stock models range from 0.8 to 2.4 gpm.

In addition to the four stock models, other combinations are available for special applications.

Detailed information and prices are published by the company.

More information? Circle Item 63 on postcard, page 85.

## Hospital Fixtures

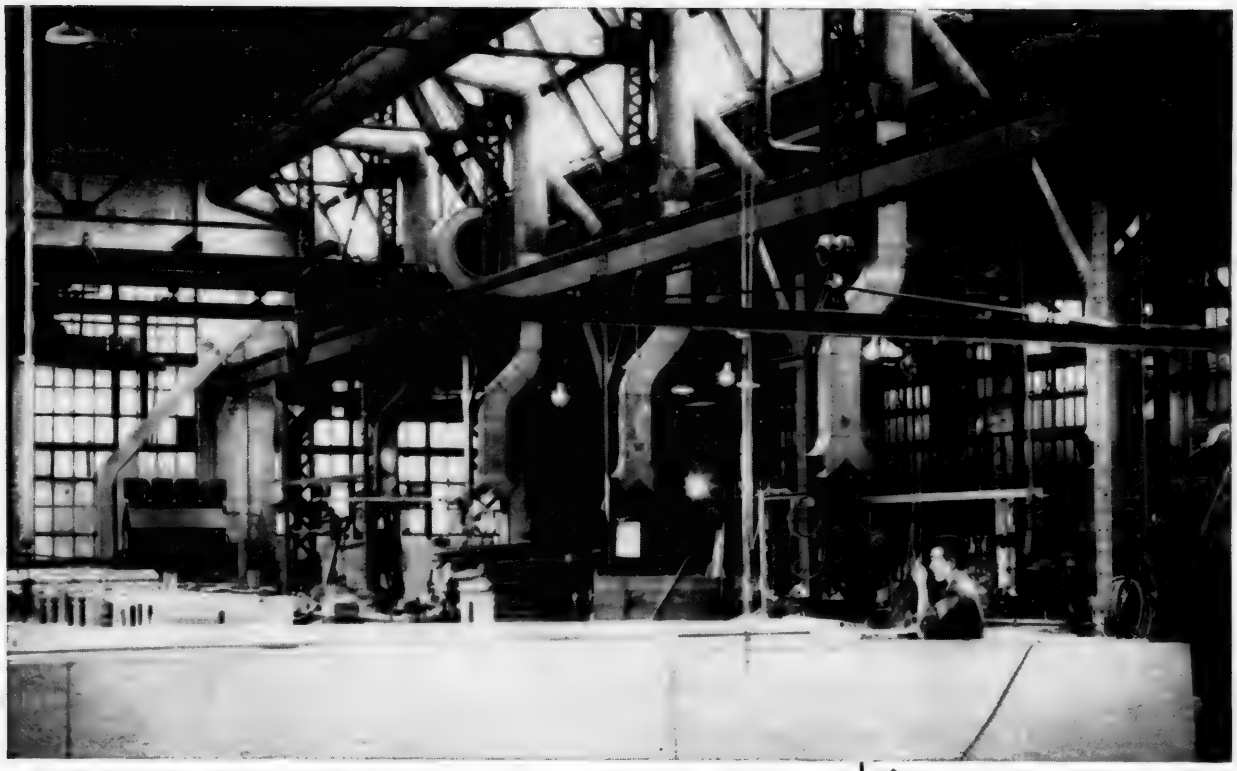
A line of hospital fixtures, combining a large drain shelf with a wash sink, is announced by Crane Co., Chicago, Ill.

Styled by industrial designer Henry Dreyfuss, the fixtures are made of a vitreous glazed earthenware, called Duraclay, that expands and contracts under extreme temperature changes, without cracking or crazing.

Designed for a range of hospital uses, the new fixtures are suitable for installations in examination or treatment rooms, central service, or for general laboratory service. They include: 1) A surgeon's lavatory and instrument tray equipped with a knee-action mixing valve, and a gooseneck spout mounted at the rear of the basin. 2) A laboratory sink with indexed, wrist-action blade handles and a gooseneck spout, all mounted at the rear of the basin. 3) An all-purpose sink with a floor mounted, double pedal, mixing valve, a gooseneck spout, and a showerhead mounted on the back. This fixture can also be furnished with a wall-mounted, foot pedal valve. 4) A surgeon's wash-up and instrument tray with wrist-action blade handles and a gooseneck spout mounted on the back.

More information? Circle Item 64 on postcard, page 85.

(*Continued on page* 136)



This Dravo *Counterflo*, on the far wall, distributes heat up to 150 feet away. Richards-Wilcox's complete Dravo system of 25 units provides 21,700,000 btu per hour to a 6 acre plant area. Ductwork visible is part of abandoned steam heating system.

At the Richards-Wilcox plant, Dravo heaters serve dual heating jobs—heating both the local area and, through duct take-offs, serve adjacent areas.

# Richards-Wilcox more than doubles heating capacity

## ...cuts heat operating costs in half!

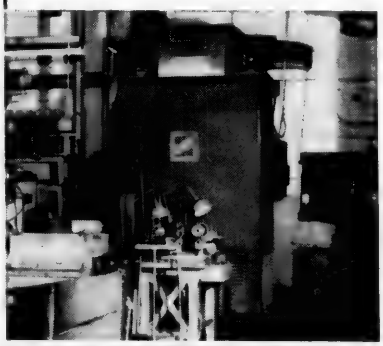
Plant heating problems first began for the Richards-Wilcox Manufacturing Co. of Aurora, Illinois, during World War II. Then, the existing steam plant, operating at full capacity, could not meet the heat requirements for new production areas. Immediate solution was the addition of two warm air space heaters.

Later, a 750,000 btu Dravo *Counterflo* heater was installed to serve additional expansion. But in 1951, facing even more expansion, Richards-Wilcox plant men thoroughly surveyed their total plant heating problem.

The existing boiler had to be modernized, an additional boiler and accessory equipment had to be added. Operating costs of this contemplated step were discouragingly high! Experience with space heaters suggested an alternative that promised real economies—dismantling of the steam plant and converting the entire plant to warm air heating. This plan was adopted on a 3 year basis.

From 1951 through 1953, twenty-four Dravo *Counterflo* heaters were put into service. Richards-Wilcox personnel installed recording instruments on every unit to determine fuel consumption and efficiency. After two years of service, the records show that Dravo heaters provided more than enough heating capacity for complete worker comfort and had *cut operating costs to less than half of the former system.* Service costs, too, were 50% less than anticipated.

Such economy is only a part of the many exclusive advantages Dravo heaters can bring in heating your plant, warehouse or building. It will pay you to thoroughly investigate quality Dravo heating systems—and see the dollars and cents reasons behind every feature. For prompt information, mail the coupon today.



Dravo Corporation, Department A-3905
Fifth & Liberty Avenues
Pittsburgh 22, Pa.

I am interested in Dravo Heaters for _____

☐ Please send literature

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Name _____

Company _____

Address _____

City _____ Zone _____ State _____

**DRAVO**
**CORPORATION**
**Pittsburgh 22, Pennsylvania**
Representatives in principal cities

(*Continued from page* 134)

## Two-Piece Tube Fittings

A line of tube fittings which consists of two parts, requires no flaring of the tube, and permits re-use of tubing is molded by Jaco Mfg. Co., Cleveland, Ohio, from Du Pont's Zytel Nylon resin.

A third part is unnecessary because the compression section is an integral part of the nut. The fittings, which can be used with any type of tubing, metal or plastic, are available for tubing with outside diameters ranging from ¼ to ½ in. Pipe sizes run from ⅛ to ½ in.

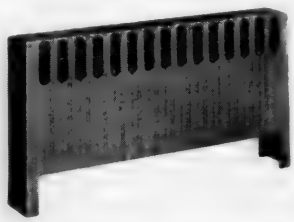
The design of these fittings does not require tubes cut to exact lengths. Connections can be made without indenting or necking the tubing, thus, both fitting and tubes can be re-used.

The fittings have been submitted to standard vibration tests and have gone to over 22 million cycles with no fracture occurring. The burst strength of the fittings is in excess of that required for the tubes for which they are intended. Because the material is a non-conductor, the danger of electrolytic corrosion at joints is eliminated.

**More information? Circle Item 65 on postcard, page 85.**

## Line of Radiators

A line of free-standing (illustrated) and recessed radiant and convection type radiators is announced by Dunkirk Radiator Corp., Dunkirk, N. Y.



Made of cast iron, the radiators, named Blue Circle are designed for a wide range of residential and non-residential uses. Integral fins direct heat outward into the room through grille openings, and, being integral, all surface is prime surface.

When installed free standing, the radiators project 5-in. into the room. They are available with or without inlet grilles at the bottom and are supplied in lengths from 9- to 99-in., in 4½-in. increments and in a 20-in. height.

No covers are required and a complete unit can be painted to conform to decorative schemes.

**More information? Circle Item 66 on postcard, page 85.**

## Two 7 ½ -Amp Room Coolers

Two room air conditioners that draw 7½ amp of electrical current are featured in the 1956 line of Yorkaire Hi-Ef room air conditioners made by York Corp., York, Pa.

Available in ½- and ¾-hp, the units produce ample cooling and usually can be installed without the added cost of re-wiring and installation of outlets. This is of particular interest to owners of older homes but applies as well to many newer homes which do not have adequate electrical facilities.

A single dial controls the fan motor, cooling, and dehumidifying of the units. A separate thermostat control may be set to any point to switch the cooling system off automatically when the room is sufficiently cooled. An outside air control dial permits regulating the amount of outside air brought into the room. All controls are located on the front of the unit and are protected by a cover to discourage tampering.

Called Power Saver, the ¾-hp air conditioners can be mounted flush with drapes inside the room, or flush with the building outside. The grille permits the cooled air to be directed to any or all parts of the room.

The cooling system is sealed with a welding flame to prevent dirt, dust, and moisture from seeping in and refrigerant from leaking out. The cooling circuit is protected for five years.

**More information? Circle Item 67 on postcard, page 85.**

## Lightweight Water Cooler

Light enough to be carried by one person, an office type water cooler, capable of cooling 2.1 gph, is made by Cordley & Hayes, New York, N. Y. The unit's cooling capacity is maintained at 90-deg F room temperatures.

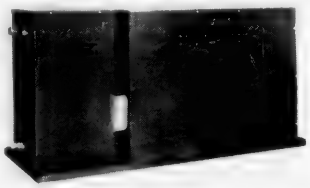
Occupying 1 sq ft of floor space, the bottle type cooler is designed for use in areas where space is at a premium. It weighs 70 lb and is 36 in. high.

Other features include a plastic bottle ring to assure purity of drinking water, a non-breakable plastic drain bucket, and thermostatic control. It uses an hermetically sealed, 1/6-hp compressor which requires no sound absorbing material. The cooler needs no plumbing connections.

**More information? Circle Item 68 on postcard, page 85.**

## Two Larger Liquid Coolers

Two larger capacity remote-type, liquid coolers are added to the line of Temprite Products Corp., Birmingham, Mich. There are now four models available in capacities ranging from 5 to 24 gph that are designed for cooling water and light oils.



The cooler can be installed in any convenient remote location and piped directly to single or multiple outlets.

In addition to drinking water cooling for restaurants, cafeterias, schools, office buildings, and factories, the units are recommended for water temperature control in photo and X-ray processing and commercial-industrial applications such as jacket cooling, coolant cooling, and welding electrode cooling.

**More information? Circle Item 69 on postcard, page 85.**

(*Concluded on page* 138)

THE MARK OF QUALITY

BARBER COLMAN

*ELECTRIC-ELECTRONIC*

**Automatic Controls**

## 22 out of 23 stores in new shopping center choose Barber-Colman Automatic Controls for

better control... electrically
CENTRAL FAN SYSTEMS
UNIT HEATERS
MULTI-ZONE UNITS
PACKAGE AIR CONDITIONERS
. . . all types of conditioned air equipment under one roof! Barber-Colman met these challenges with simpler, faster, more flexible automatic controls.

New Shelbyville Road Plaza Shopping Center, near Louisville, Kentucky

General contractors: Dahlem Construction Company, Louisville
Air Conditioning contractors: The Stewart Distributing Company, Louisville

The new Shelbyville Road Plaza, just out of Louisville, is typical of the fast nationwide trend towards modern merchandising centers. Just as typical is the trend towards electric-electronic control of heating and air conditioning. With electricity, you get instantaneous action, and true positive positioning control. Join the trend to "better control . . . electrically."

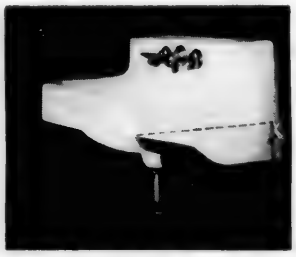
**Barber-Colman Company**

DEPT. E, 1302 ROCK ST., ROCKFORD, ILLINOIS, U. S. A.
*Field Offices in principal cities*

(*Concluded from page 136*)

## Lavatory Hangs on Wall

A wall-hanging shelf lavatory, named Juneau, has been designed by Kohler Co., Kohler, Wis., for use in schools, apartments, hospitals, hotels, and other public buildings.



A feature of the fixture is its integral wall support which gives it four additional inches of wall bearing surface. Two screw holes are provided on the under side of the lavatory for anchoring it to the wall.

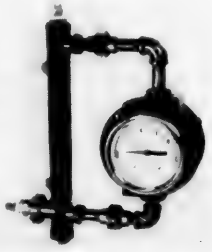
Measuring 19 x 17 in., the fixture is recommended for use either singly or in batteries. It is made of vitreous china and has a glass-hard surface. Its 4½-in. shelf is unobstructed, with fittings mounted over the basin, and the 4-in. back protects the wall against splashing.

The company is optionally furnishing the fixture drilled for the installation of a soap dispenser.

More information? Circle Item 70 on postcard, page 85.

## Air or Gas Flowmeter

A vane-type flowmeter for air or gas, No. 1050, is being offered by Instrument Div., Scully-Jones and Co., Chicago, Ill. The instrument is designed for a constant pressure drop across the meter and may be used for indicating, controlling, signal alarm, safety shutoff, sequence starting or shutdown, and similar applications.



The operation of the flowmeter is as follows: As the vane rotates with an increase in flow, the area between the end of the vane and the flexible spline in the meter body increases. This increase approximates the law of squares. By varying the weight of the vane, and the area, various capacities can be produced. The area is shaped to provide an evenly divided scale, and the pointer movement on the dial is multiplied by gearing to produce a dial that is easily read at a distance.

Adjustments are provided to correct calibration for densities of different gases. The adjustments move the interior curved spine, changing the distance between the vane and spine. The meter cannot be damaged by excess flow or pressure. It is calibrated against gravity and has no springs, bellows, or diaphragms. Because it is a dry meter, there are no liquid columns to blow, and no zero adjustments necesary.

The flowmeter is made in three standard body sizes with standard scale diameters of 4½ and 6 in. Readable accuracy is 0.5% and calibrated accuracy from 2 to 5%, depending on scale range and diameter. For scale ranges up to 50 cfm, all the gas passes through the meter making it practically independent of pipe restrictions and elbows. Scale ranges over 50 cfm are connected in shunt (as illustrated) in any of a number of different possible arrangements.

The meter body and companion parts are made of aluminum with brass or stainless steel trim. The meter can be used as a wall or panel-mounted instrument.

More information? Circle Item 71 on postcard, page 85.

## Low Pressure Pipe

General purpose plastic pipe is introduced by Chesflex Corp., Yonkers, N. Y., for low pressure installations.

The general purpose pipe is being made for use on jobs not requiring the extra pressure protection provided by 75- or 100-lb pressure pipe. It is made of virgin resin, polyethylene and will be available in sizes from ½ to 4 in.

When used according to its temperature and pressure specifications, the pipe is guaranteed for 20 years in the sun and for 30 years in the ground. It is recommended for all low pressure applications, for electrical and telephone conduits, and for the industrial piping of corrosive liquids.

More information? Circle Item 72 on postcard, page 85.

## Make-Up Air Washers

A line of rubber lined, acid-proof air washers is made by Automotive Rubber Co., Inc., Detroit, Mich.

Designed for integration into plant ventilation systems, the units constitute ARco air wash systems. They are capable of eliminating toxic fumes and corrosives from exhaust gases.

The washers are equipped optionally with a straight-through air inlet and discharge (illustrated); with a bottom air inlet and a top air discharge; or with an end inlet and end discharge and an added downstream access hatch. Standard units are available in capacities from 7200 to 57,600 cfm.

Fabricated of 3/16-in. steel plate, the cross flow type washers are welded inside and out. The steel shell is sand blasted and lined with sheet rubber. All outlets are face-lined with rubber, continuous with the inside membrane. The units have no moving parts.

Each unit is provided with a lengthwise sump approximately 10 x 12 in. and flanged, 2-in., side outlets for connection to the recirculation system, overflow line, quick dumping line, steam line for outside installation winter heating, make up water line, and quick-fill line. One flanged, 2-in., top inlet leading to the distribution system is also provided. One 16 x 24-in. access hatch is a standard component on each of the units. Other accessories are provided to meet special conditions and specifications.

The liquid distribution system of the air washers is a gravity feed, overflow type to prevent clogging and to eliminate back pressure on the recirculation or water feed line.

More information? Circle Item 73 on postcard, page 85.

There's MORE rating selection available in Allis-Chalmers MOTORS

*To meet your needs...*

# Allis-Chalmers Offers Complete Line of Rib-Type MOTORS from 1 to 100 Hp

Allis-Chalmers, a pioneer in rib-type TEFC motor design, is the only leading manufacturer offering a complete line of these motors from 1 to 100 hp. The many cost-saving features of deep-rib construction can be applied in a variety of uses... both indoors and out.

*Here's why these motors can cut service costs:*

**MORE cooling surface** — Rib-type design provides reserve cooling capacity in dirty locations.

**MORE iron**—Cast-iron frame and external parts assure rigidity and resistance to corrosion.

**MORE copper** — Allis-Chalmers greater use of copper increases electrical life.

**MORE lubrication provisions** — Large grease reservoirs surround bearings. Provision made for in-service relubrication — important where moisture or corrosive vapors contaminate grease.

---

As a new machinery component or as replacement, specify Allis-Chalmers. To find out more, contact your nearby Allis-Chalmers distributor, district office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

A-4943

# ALLIS-CHALMERS

# BOOK REVIEWS

*Publications abstracted in this department should be ordered direct from publisher.*

## REFRIGERATION MANUAL

A new third edition of the Trane Refrigeration Manual has been published by The Trane Company following a complete revision of its text to include up-to-date developments on installation, operation and servicing of refrigeration equipment.

The purpose of the manual is to aid the contractor and others interested in understanding equipment used in the refrigeration industry.

Now in its fourteenth printing since first published in 1946, the manual includes new information on condenser fouling factors, motors and motor control equipment, mufflers, single and multiple compressor piping arrangements, calculating Freon-22 piping sizes, pipe hanging and insulation of piping, and Freon-22 charging.

In addition, new tables have been added to the chapter devoted to thermostatic expansion valves. These include capacity tables, and tables concerning factors which affect their selection. All components of refrigeration systems are discussed in the manual.

*Trane Refrigeration Manual, The Trane Co., La Crosse, Wis. Has 24 chapters, 133 pages. Price $1.50.*

## 1956 GUIDE

The Heating Ventilating Air Conditioning Guide 1956, the 34th edition published by the American Society of Heating and Air-Conditioning Engineers, is now available and contains the latest technical and equipment information of interest to the profession and industry. The technical data section of this 34th edition contains 1,176 pages. The catalog data section presents material concerning the products of 335 manufacturers.

Particular attention has been given to the presentation of heat transmission coefficients of building materials. An important result is that the design values for conductivity and conductance are included for many more materials than in any other previous Guide. More tables make it easy to compute the effect of adding air spaces or insulations to walls, ceilings or floors.

Other material which has been rewritten is that concerned with automatic control and a description of current control equipment using the latest nomenclature.

The technical data continue to be presented in 53 chapters grouped under seven sections.

*1956 Guide. Available at $12. Size 6 x 9 inches, blue cloth bound. American Society of Heating and Air-Conditioning Engineers, 62 Worth St., New York 13, N. Y.*

## AIR CONDITIONING RATINGS

Two new standards on the testing and rating of air-conditioning and refrigeration equipment have been drafted and published by Air-Conditioning and Refrigeration Institute.

The first (ARI Standard 410-56, Forced Circulation Air-Cooling Coils) specifies minimum requirements for forced-circulation air-cooling coils for application under nonfrosting conditions and applies to air-cooling coils using either water or volatile refrigerants. This Standard includes minimum equipment, methods of rating and testing, design, construction and safety provisions.

The other (ARI Standard 411, Standard for Methods of Testing and Rating Forced-Circulation Air-Cooling and Air-Heating Coils) prescribes methods of testing and rating both air-cooling and air-heating coils to assure uniform capacity information on the coils. It also describes and specifies the basis of rating, test equipment and apparatus, test methods and procedures, test data, calculations to be made from test data, and a definition of terms to be used in testing and rating of equipment.

*ARI Standards, published by Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N. W., Washington 6, D. C., Standard 410-56, 25 cents, Standard 411, $1 a copy.*

## SOLAR ENERGY

The Association for Applied Solar Energy has announced the publication of the proceedings of the World Symposium on Applied Solar Energy. Published by Stanford Research Instiute for the Association, the proceedings is considered a major publication in the solar energy field. Running 300 pages, it contains 30 papers by internationaly recognized authorities on solar energy.

Subjects include solar water heaters, solar collector design, solar energy conversion and algal culture studies. An opening 7-page section contains pictorial highlights of symposium sessions and of the Solar Engineering Exhibit, held in conjunction with the symposium. Final section is a summary of the concluding session, a round-table discussion, which deals with The Future of Applied Solar Energy.

*Available from the Association for Applied Solar Energy, 204 Heard Building, Phoenix, Ariz. Price, $5.*

## COMPACT HEAT EXCHANGERS

A comprehensive treatment of compact heat transfer surfaces, including all of the types in use today, is contained in Compact Heat Exchangers, by W. M. Kays and A. L. London, professors of mechanical engineering, Stanford University, Palo Alto, Calif.

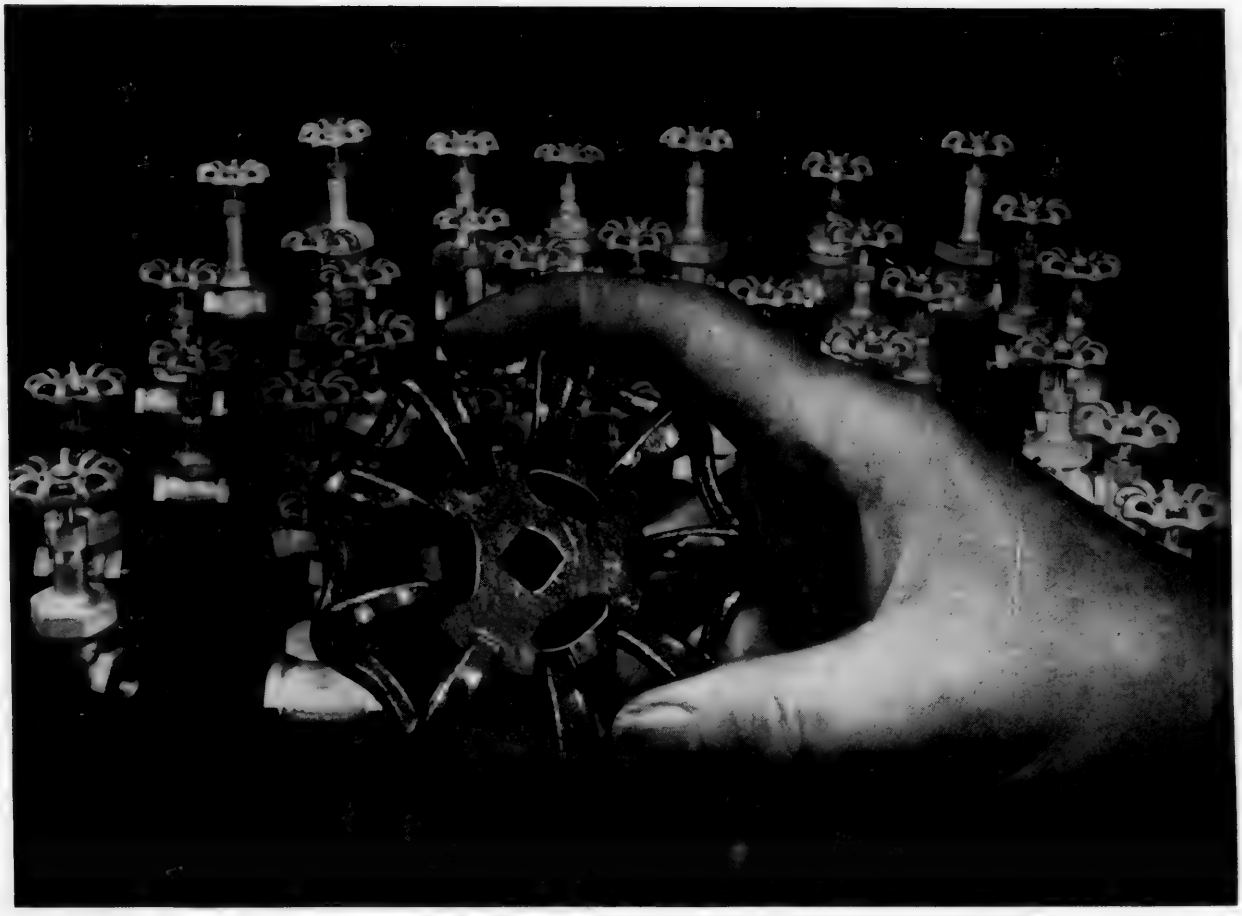
The objectives of the authors are to make available to heat exchanger designers, the results of experimental and analytical work on compact heat transfer surfaces. As the result of projects initiated by the Office of Naval Research, 22 reports were issued since 1948 that dealt with compact heat transfer surfaces. This book presents in one volume a common treatment of all the data in these reports. Also included in the book are supplementary data of other investigations.

A chapter is devoted to heat exchanger performance theory developed around the effectiveness versus number of heat transfer units concept. Sample problems, based on this theory, are included in an appendix.

A substantial part of the data presented was formerly only available in research reports.

*Compact Heat Exchangers, by W. M. Kays and A. L. London. Cloth bound, 8¼ x 10¾ inches, 156 pages. Published by The National Press, Palo Alto, Calif. Price, $5.*

*(Continued on page 142)*



# One handwheel fits 40* different valves

| *Walworth Handwheel No. 16 fits these Walworth Bronze Valves: | |
|---|---|
| 3/4" | No. 32, 40, 47, 48, 205, 206, 225P, 227P, 260, 261, 260P, 261P |
| 1" | No. 29, 30, 36, 37, 91, OX91, 92, 95, 96, 160, 161, 235, 236, 245, 246, 245P, 246P, 237P, 238P |
| 1¼" | No. 58, 59 |
| 1½" | No. 2, 3, 4, 11, 12, 14 . 24 |

## Only Walworth Bronze Valves give you this degree of interchangeability

With standardized Walworth Bronze Valve parts you maintain the greatest number of valves with the smallest inventory of basic parts. Handwheels are just one example. Fourteen different sizes of handwheels are all you need for fifty lines of gate, globe, and angle valves, involving 420 individual valves.

The Walworth system of interchangeability of parts for Bronze Valves is unsurpassed by any manufacturer in the field. In addition to Bronze Valves, Walworth produces valves and pipe fittings of iron, steel, special alloys, and rigid polyvinyl chloride (PVC).

Learn more about Walworth interchangeability. Contact your local Walworth Distributor or nearby Walworth Sales Office. Ask for literature.

# WALWORTH

60 East 42nd Street, New York 17, New York

SUBSIDIARIES: ALOYCO ALLOY STEEL PRODUCTS CO. CONOFLOW CORPORATION M&H VALVE & FITTINGS CO. SW SOUTHWEST FABRICATING & WELDING CO., INC. WALWORTH COMPANY OF CANADA, LTD.

(*Continued from page* 140)

## COOLING GUIDE

A step-by-step procedure for calculating of residential cooling loads is presented in the new I-B-R Guide C-30, published by the Instiute of Boiler and Radiator Manufacturers and available June 1. The guide is prepared for use by anyone in the heating-cooling field, regardless of previous experience or technical training. It was particularly designed to save the installer time, effort and error by eliminating much of the long-hand figuring conventionally required.

Guide C-30 incorporates many time-saving features, such as consolidated tables for determining area and volume without use of mathematics.

Also included in the cooling guide are definitions of basic terms (cooling load, dew point, refrigeration cycle, etc.). Another section outlines the importance and procedure for making a survey prior to computing a cooling load. This is followed by a listing of 11 steps which will accurately take the installer from start to finish in his calculation.

New calculation sheets, designated No. 3001, have been prepared for use along with the cooling guide. They are designed for logical recording of information as the calculation procedure is followed. Contractors have long been familiar with similar calculation sheets which are used with various other I-B-R guides.

*I-B-R Guide C-30. Prices: $1 for the guide and $1.25 for 50 calculation sheets. Available from Instiute of Boiler and Radiator Manufacturers, 608 Fifth Ave., New York, N. Y.*

• • •

DRAINAGE FITTINGS—American Standard Cast-Brass Solder-Joint Drainage Fittings, B16.23-1955, a 21-page document covering all cast-brass solder-joint drainage fittings designed for use with copper water tube, is available from American Standards Association, 70 East 45th St., New York 17, N. Y., at $1.25 a copy. It describes various types and gives standard pitches, abbreviations for connections and standard sizes, and also shows standard methods of designating openings for reducing fittings, nationally-agreed upon markings and tolerances, and minimum requirements for material. This standard is a revision of the American Standard of the same name which was approved in 1953. The new edition has been expanded to include two sizes of closet one-quarter bends, and a series of reducing sizes for 45 degree Y, long turn T-Y and double long turn T-Y fittings. It contains 12 tables, 70 diagrams.

THERMODYNAMICS—A standard size book, "Principles of Chemical Engineering Thermodynamics", by Ernest D. Wilson, Professor of Chemical Engineering and Chemistry, Worcester Polytechnic Institute, and Harold C. Ries, Shell Development Company. In this book, thermodynamics is presented as a tool and a method of approach to the solution of industrial problems. The book is one of the publisher's Chemical Engineering Series. Price $7.50. Published by McGraw-Hill Book Co., 330 W. 41st St., New York, N. Y.

PIPING IDENTIFICATION—A revised American Standard scheme for the identification of piping systems (ASA A13.1-1956) has been published by the American Society of Mechanical Engineers and is available from that organization at 29 W. 39th Street, New York 18, N. Y. Price $1. It covers a systematic plan for identifying the contents of a piping system from markings and coloring of the pipe line.

MASS TRANSFER OPERATIONS—This book, one of the publishers' series on chemical engineering, introduces the reader to the general features of diffusion and the techniques used in humidification and dehumidification, gas absorption, distillation, drying, thermal diffusion and similar mass transfer operations. The author is Robert E. Treybal, Professor of Chemical Engineering, New York University. 666 pages. Price $9.50. Published by the McGraw-Hill Book Co., 330 W. 41st St., New York, N. Y.

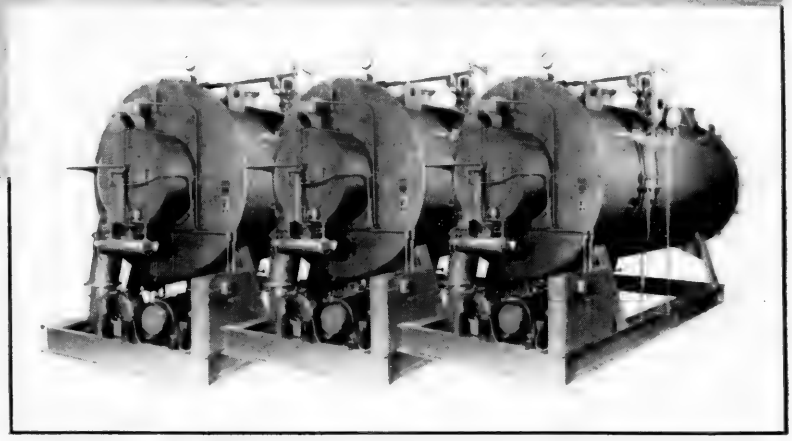
PETROLEUM PRODUCTS—A compilation prepared by American Society for Testing Materials Committee D-2 entitled ASTM Standards on Petroleum Products and Lubricants includes tentative and standard methods of test, specifications, definitions of terms and classifications of petroleum products and lubricants, together with related information, including the Report of Committee D-2 and many proposed methods of test. The compilation has been published annually since 1927. The new edition includes 159 standards, 41 of which are new or revised since the previous edition. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price, $7.15 for cloth and $6.50 for paper covers.

FREON-12 TABLES—A new compilation entitled Thermodynamic Properties of Freon-12 has been issued by Kinetic Chemicals Div., Organic Chemicals Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del. Earlier tables, developed from two sets of equations, contained a slight discontinuity in data; the new tables are complete, consistent and continuous throughout the entire pressure and temperature range.

HEAT LOSSES—"Calculating Heat Losses" is the title of a new second edition of Manual 3 of the National Warm Air Heating and Air Conditioning Association, 640 Engineers Building, Cleveland 14, Ohio. It covers a simplified method which is thoroughly and carefully explained and includes heat loss coefficients for common types of building construction. Also included is a sample form to be used for making heat loss calculations. Price 60 cents.

PHYSICAL-CHEMICAL PROPERTIES OF ETHANE-NITROGEN MIXTURES—The Institute of Gas Technology has issued Research Bulletin 26 on Physical-Chemical Properties of Ethane-Nitrogen Mixtures. This completes the series on methane-ethane-nitrogen systems. It presents data on liquid-vapor phase equilibria, gas phase pressure-volume-temperature relationships, and saturated liquid and vapor densities for the ethane-nitrogen systems. Institute of Gas Technology, 17 W. 34th St., Technology Center, Chicago 16, Ill. Price, $5.

# This Multi-million dollar Shopping Center is a *Nickel Spender* for heat and power



Recently completed O'Neil-Sheffield Shopping Center in Sheffield Township, Ohio.

Architects: Weinberg and Teare, Cleveland, Ohio.

Consulting Engineers: Superior Engineering Company, Cleveland, Ohio.

Heating Contractor: T. O. Murphy, Oberlin, Ohio.

York-Shipley Distributor: Allied Oil Company, Cleveland, Ohio.

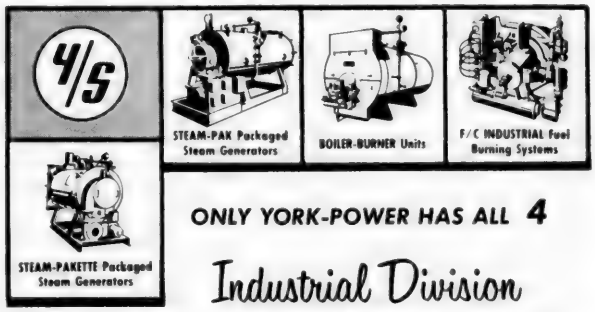
## . . . thanks to three York-Power Steam-Pak Generators that operate only as the load demands

The larger the project, the more accurately you've got to figure operating costs—so argued the Architects and Engineers responsible for the mammoth O'Neil-Sheffield shopping center illustrated above.

With inefficient equipment, these men realized their heating costs might easily get out of hand. For this reason, they specified and installed thrifty, efficient York-Power Steam-Paks.

The 39 stores in this modern shopping center are hooked into a heating circuit powered by 3 York-Power SPW400-6 Steam-Paks. They are equipped with full modulation and each cuts in automatically *only as the load demands.* Under ordinary conditions, only one generator is required for the entire operation.

Find out how York-Power units can mean maximum economy and efficiency for your installation. You can depend on your nearest York-Shipley Representative for full cooperation. Call him today.




ONLY YORK-POWER HAS ALL 4

*Industrial Division*

**YORK-SHIPLEY, INC.**

YORK, PENNSYLVANIA

# DEGREE-DAYS FOR MARCH, 1956

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

AIR CONDITIONING, HEATING AND VENTILATING's 28th Year of Publication of Monthly Degree-Day Data

| City | March | | | Season to March 31, incl.* | | |
|---|---|---|---|---|---|---|
| | 1956 | 1955 | Normal | 1955-56 | 1954-55 | Normal |
| Abilene, Texas (A) | 245 | 275 | 344 | 2450 | 2193 | 2594 |
| Albany, New York (A) | 1145 | 982 | 989 | 6306 | 5867 | 6045 |
| Albuquerque, New Mexico (A) | 483 | 538 | 589 | 3547 | 3865 | 4030 |
| Alpena, Michigan (C) | 1226 | 1162 | 1156 | 6668 | 6406 | 6604 |
| Anaconda, Montana (C) | (a) | 1323 | 1081** | (a) | 6735 | 6737** |
| Asheville, North Carolina (C) | 550 | 491 | 572 | 3804 | 3849 | 3677 |
| Atlanta, Georgia (A) | 348 | 304 | 404 | 2703 | 2695 | 2673 |
| Atlantic City, New Jersey (C) | 768 | 658 | 729 | 4218 | 4072 | 4060 |
| Augusta, Georgia (A) | 319 | 264 | 308 | 2481 | 2471 | 2076 |
| Baltimore, Maryland (C) | 663 | 549 | 611 | 3994 | 3791 | 3804 |
| Billings, Montana (A) | 918 | 1199 | 958 | 6540 | 5864 | 6091 |
| Binghamton, New York (C) | 1068 | 897 | 927 | 5900 | 5550 | 5662 |
| Birmingham, Alabama (A) | 354 | 286 | 378 | 2681 | 2634 | 2630 |
| Bismarck, North Dakota (A) | 1281 | 1283 | 1187 | 8833 | 7379 | 7839 |
| Block Island, Rhode Island (A) | 948 | 843 | 865 | 4946 | 4597 | 4782 |
| Boise, Idaho (A) | 710 | 887 | 719 | 5107 | 5492 | 5096 |
| Boston, Massachusetts (A) | 966 | 841 | 849 | 5217 | 4793 | 4972 |
| Bozeman, Montana (C) | (a) | 1333 | 1096** | (a) | 6884 | 6993** |
| Buffalo, New York (A) | 1062 | 959 | 992 | 5857 | 5530 | 5769 |
| Burlington, Iowa (A) | 821 | 838 | 822 | 5730 | 5344 | 5463 |
| Burlington, Vermont (A) | 1273 | 1126 | 1107 | 6920 | 6627 | 6739 |
| Butte, Montana (C) | (a) | 1355 | 1048** | (a) | 7152 | 6683** |
| Cairo, Illinois (C) | 479 | 492 | 523 | 3642 | 3458 | 3527 |
| Charleston, South Carolina (C) | 235 | 169 | 260 | 1795 | 1791 | 1726 |
| Charlotte, North Carolina (A) | 430 | 356 | 449 | 3003 | 2997 | 3004 |
| Chattanooga, Tennessee (A) | 427 | 375 | 467 | 3231 | 3190 | 3160 |
| Cheyenne, Wyoming (A) | 986 | 1116 | 1029 | 6087 | 6921 | 6138 |
| Chicago, Illinois (C) | 859 | 848 | 845** | 5178 | 4963 | 5246** |
| Cincinnati, Ohio (C) | 625 | 553 | 645 | 4108 | 3925 | 4110 |
| Cleveland, Ohio (A) | 891 | 812 | 874 | 5293 | 3985 | 5196 |
| Columbia, Missouri (A) | 647 | 663 | 698 | 4692 | 4346 | 4632 |
| Columbia, South Carolina (A) | 333 | 261 | 318 | 2545 | 2557 | 2207 |
| Columbus, Ohio (C) | 768 | 701 | 741 | 4857 | 4548 | 4694 |
| Concord, New Hampshire (A) | 1218 | 1031 | 1029 | 6593 | 6117 | 6486 |
| Concordia, Kansas (C) | 717 | 767 | 725 | 5245 | 4692 | 4816 |
| Dallas, Texas (A) | 244 | 276 | 288 | 2244 | 2094 | 2197 |
| Dayton, Ohio (A) | 811 | 742 | 781 | 5137 | 4883 | 4938 |
| Deer Lodge, Montana (C) | (a) | 1293 | 1056** | (a) | 7121 | 7125** |
| Denver, Colorado (A) | 764 | 878 | 800 | 5021 | 5111 | 5073 |
| Des Moines, Iowa (A) | 916 | 902 | 868 | 6213 | 5646 | 5745 |
| Detroit, Michigan (A) | 1003 | 900 | 558 | 5614 | 5328 | 5527 |
| Devils Lake, North Dakota (C) | 1527 | 1564 | 1314 | 9593 | 8294 | 8551 |
| Dodge City, Kansas (A) | 614 | 703 | 694 | 4640 | 4318 | 4561 |
| Dubuque, Iowa (A) | 1038 | 1023 | 983 | 6644 | 6266 | 6349 |
| Duluth, Minnesota (C) | 1360 | 1474 | 1252 | 8361 | 7994 | 7929 |
| Elkins, West Virginia (A) | 799 | 714 | 797 | 5243 | 5151 | 4979 |
| El Paso, Texas (A) | 238 | 284 | 330 | 2112 | 2457 | 2531 |
| Ely, Nevada (A) | 901 | 1034 | 921 | 6152 | 6726 | 6120 |
| Escanaba, Michigan (C) | 1284 | 1226 | 1203 | 7029 | 6718 | 7059 |
| Evansville, Indiana (A) | 619 | 586 | 589 | 4281 | 4069 | 4013 |
| Fargo, North Dakota | 1406 | 1487 | 1231 | 8932 | 8024 | 8082 |
| Fort Smith, Arkansas (A) | 407 | 419 | 418 | 3251 | 3014 | 3037 |
| Fort Wayne, Indiana (A) | 889 | 840 | 874 | 5579 | 5257 | 5475 |
| Fort Worth, Texas (A) | 260 | 284 | 308 | 2294 | 2136 | 2266 |
| Fresno, California (A) | 340 | 337 | 304 | 2350 | 2652 | 2344 |
| Galveston, Texas (C) | 123 | 142 | 176 | 1000 | 981 | 1181 |
| Grand Junction, Colorado (A) | 695 | 816 | 738 | 4647 | 5507 | 5226 |
| Grand Rapids, Michigan (A) | 1076 | 982 | 1008 | 6087 | 5754 | 6041 |
| Green Bay, Wisconsin (A) | 1265 | 1176 | 1132 | 7267 | 6912 | 7019 |
| Greensboro, North Carolina (A) | 554 | 452 | 528 | 3721 | 2639 | 3519 |
| Greenville, South Carolina (A) | 417 | 377 | 442 | 3004 | 3015 | 2867 |
| Harrisburg, Pennsylvania (A) | 824 | 705 | 750 | 4855 | 4648 | 4693 |
| Hartford, Connecticut (A) | 1007 | 883 | 871 | 5561 | 5205 | 5365 |
| Hatteras, North Carolina (C) | 418 | 291 | 394 | 2589 | 2382 | 2196 |
| Havre, Montana (C) | 1008 | 1279 | 1076 | 8094 | 6562 | 7120 |
| Helena, Montana (A) | 971 | 1357 | 1017 | 7454 | 7008 | 6952 |
| Houston, Texas (C) | 131 | 157 | 166 | 1122 | 1116 | 1249 |
| Huron, South Dakota (A) | 1187 | 1130 | 1032 | 8149 | 6820 | 6959 |
| Indianapolis, Indiana (A) | 763 | 751 | 772 | 5123 | 4883 | 4973 |
| Jackson, Mississippi (A) | 310 | 242 | 299 | 2296 | 2187 | 2121 |
| Kansas City, Missouri (A) | 613 | 657 | 666 | 4593 | 4186 | 4477 |
| Knoxville, Tennessee (A) | 466 | 404 | 500 | 3457 | 3404 | 3344 |
| La Crosse, Wisconsin (A) | 1198 | 1123 | 1035 | 7212 | 6580 | 6743 |

(a) Data not available.
*Heating season cumulative, from Sept. 1.
**Same normal figures as previously listed by HEATING AND VENTILATING since new figures are not available. All other normal figures in this table are based on a 30-year period covering 1921 to 1950, inclusive, recently compiled and published by the U. S. Weather Bureau.

Figures in this table, with eight exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company. Tacoma figures through the courtesy of the Tacoma News Tribune.

[Table concluded on page 146]

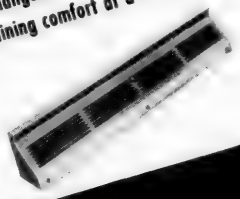
...condensed consumer reports
from the files of

# standard

registers
and grilles

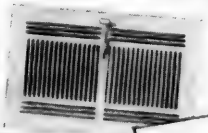
**B-24 PERIMETER BASEBOARD DIFFUSERS**

Mad Maud used to fume
When air blasts blew her from the room,
But B-24 changed her wrath to revel,
By maintaining comfort at a very high level!



**PERIMETER BASEBOARD REGISTER NO. 551**

Frozen Frank was in a snit;
found cold corners wherever he'd sit.
But with the 551's four way diffusion,
He now has comfort in profusion!



**PH SERIES PERIMETER FLOOR REGISTERS**

When Circle Sal entertained the ladies,
They found her home as hot as hades.
PH Registers restored her station,
Through perfect heat regulation!

**CEILING AIR DIFFUSERS**

Sinus Sam was a martyr true;
Stuffy air turned him blue,
'Til he put Ceiling Air Diffusers in.
Now he's in the pink again!

MORAL: If you want to keep
your customers happy
mail this coupon
and make it snappy!

**STANDARD**

...first in engineering for indoor comfort

**STANDARD STAMPING & PERFORATING CO.**
3141 W. 49th Place, Chicago 32, Illinois

Gentlemen: Please send me your new catalog showing the complete line of STANDARD STAMPING REGISTERS AND GRILLES.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____

# Degree-Days for March, 1956 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

AIR CONDITIONING, HEATING AND VENTILATING's 28th Year of Publication of Monthly Degree-Day Data

| City | March | | | Season to March 31, incl.* | | |
|---|---|---|---|---|---|---|
| | 1956 | 1955 | Normal | 1955-56 | 1954-55 | Normal |
| Lander, Wyoming (A) | 997 | 1199 | 1045 | 6849 | 6521 | 7027 |
| Lewiston, Maine (O) | 1176 | 1025 | 1093 | 6323 | 6183 | 6625 |
| Lincoln, Nebraska (C) | 797 | 839 | 794 | 5663 | 5196 | 5277 |
| Little Rock, Arkansas (A) | 385 | 388 | 401 | 2938 | 2787 | 2842 |
| Livingston, Montana (C) | (a) | 1178 | 967** | (a) | 6187 | 5985** |
| Los Angeles, California (C) | 150 | 142 | 212 | 1246 | 1034 | 1235 |
| Louisville, Kentucky (A) | 584 | 542 | 611 | 4069 | 3982 | 4055 |
| Lynchburg, Virginia (A) | 606 | 504 | 584 | 3965 | 3880 | 3777 |
| Macon, Georgia (A) | 269 | 214 | 275 | 2155 | 2128 | 1987 |
| Madison, Wisconsin (C) | 1064 | 1067 | 1011 | 6503 | 6240 | 6342 |
| Marquette, Michigan (C) | 1227 | 1241 | 1181 | 6899 | 6752 | 6918 |
| Memphis, Tennessee (A) | 425 | 398 | 427 | 3063 | 2964 | 2974 |
| Meridian, Mississippi (A) | 285 | 239 | 309 | 2312 | 2321 | 2239 |
| Milwaukee, Wisconsin (A) | 1036 | 1021 | 983 | 6147 | 5838 | 6072 |
| Minneapolis, Minnesota (A) | 1204 | 1211 | 1057 | 7626 | 6957 | 6919 |
| Moline, Illinois (A) | 890 | 891 | 862 | 5891 | 5610 | 5659 |
| Montgomery, Alabama (A) | 274 | 210 | 288 | 2164 | 2184 | 2057 |
| Nantucket, Massachusetts (A) | (a) | 863 | 880 | (a) | 4672 | 4871 |
| Nashville, Tennessee (A) | 479 | 448 | 498 | 3465 | 3423 | 3284 |
| New Haven, Connecticut (A) | 959 | 856 | 865 | 5214 | 4925 | 5128 |
| New Orleans, Louisiana (C) | 103 | 127 | 163 | 1143 | 1101 | 1156 |
| New York, New York (C) | 836 | 733 | 753 | 4553 | 4362 | 4423 |
| Newark, New Jersey (A) | 864 | 723 | 760 | 4699 | 4439 | 4643 |
| Norfolk, Virginia (A) | 527 | 388 | 500 | 3297 | 3188 | 3130 |
| North Platte, Nebraska (A) | 856 | 950 | 887 | 6297 | 5959 | 5738 |
| Oak Ridge, Tennessee (C) | 456 | 465 | 633 | 3582 | 3649 | 3743 |
| Oakland, California (A) | 409 | 386 | 360 | 2659 | 2470 | 2389 |
| Oklahoma City, Oklahoma (A) | 464 | 491 | 472 | 3641 | 3265 | 3312 |
| Omaha, Nebraska (A) | 841 | 880 | 831 | 5934 | 5347 | 5559 |
| Parkersburg, West Virginia (C) | 690 | (a) | 672 | 4440 | (a) | 4271 |
| Peoria, Illinois (A) | 801 | 836 | 828 | 5462 | 5229 | 5408 |
| Philadelphia, Pennsylvania (C) | 795 | 632 | 667 | 4246 | 4019 | 4061 |
| Phoenix, Arizona (A) | 131 | 117 | 175 | 1263 | 1396 | 1430 |
| Pittsburgh, Pennsylvania (C) | 759 | 656 | 735 | 4628 | 4427 | 4496 |
| Pittsfield, Mass. (A) | 1204 | 1054 | 1060 | 6732 | 6299 | 6475 |
| Pocatello, Idaho (A) | 900 | 1076 | 880 | 6006 | 6632 | 5962 |
| Portland, Maine (A) | 1213 | 1065 | 1039 | 6596 | 6069 | 6406 |
| Portland, Oregon (C) | 589 | 686 | 515 | 3848 | 3528 | 3500 |
| Providence, Rhode Island (A) | 986 | 861 | 874 | 4365 | 4967 | 5213 |
| Pueblo, Colorado (A) | 747 | 774 | 775 | 4935 | 4781 | 5023 |
| Raleigh, North Carolina (A) | 506 | 372 | 440 | 3402 | 3263 | 2874 |
| Rapid City, South Dakota (A) | 953 | 1119 | 1045 | 6560 | 6001 | 6359 |
| Reading, Pennsylvania (C) | 820 | 688 | 725 | 4648 | 4434 | 4510 |
| Red Bluff, California (A) | 341 | 336 | 336 | 2395 | 2615 | 2318 |
| Reno, Nevada (A) | 723 | 808 | 756 | 5056 | 5356 | 4946 |
| Richmond, Virginia (A) | 578 | 450 | 550 | 3783 | 3650 | 3618 |
| Rochester, New York (A) | 1118 | 984 | 992 | 6103 | 5727 | 5862 |
| Roswell, New Mexico (A) | 384 | 418 | 443 | 3208 | 3232 | 3211 |
| Sacramento, California (C) | 297 | 319 | 317 | 2163 | 2555 | 2314 |
| St. Joseph, Missouri (A) | 731 | 749 | 648 | 5259 | 4844 | 4294 |
| St. Louis, Missouri (C) | 589 | 611 | 620 | 4238 | 3999 | 4098 |
| Salt Lake City, Utah (A) | 694 | 871 | 741 | 4942 | 5560 | 5099 |
| San Antonio, Texas (A) | 140 | 168 | 190 | 1435 | 1213 | 1545 |
| San Diego, California (A) | 208 | 163 | 223 | 1270 | 1065 | 1265 |
| Sandusky, Ohio (C) | 903 | 805 | 853 | 5297 | 4919 | 5088 |
| San Francisco, California (C) | 346 | 311 | 317 | 2133 | 2114 | 1996 |
| Sault Ste. Marie, Michigan (A) | 1381 | 1379 | 1302 | 7605 | 7378 | 7671 |
| Savannah, Georgia (A) | 253 | 185 | 238 | 1903 | 1980 | 1667 |
| Scranton, Pennsylvania (A) | 1033 | 844 | 859 | 5825 | 5250 | 5282 |
| Seattle, Washington (C) | 669 | 721 | 558 | 4126 | 3598 | 3595 |
| Sheridan, Wyoming (A) | 1027 | 1298 | 1035 | 6894 | 6375 | 6642 |
| Shreveport, Louisiana (A) | 267 | 249 | 272 | 2078 | 2008 | 2056 |
| Sioux City, Iowa (A) | 967 | 985 | 930 | 6666 | 6956 | 6231 |
| Spokane, Washington (A) | 890 | 1041 | 834 | 6294 | 5835 | 5770 |
| Springfield, Illinois (A) | 730 | 762 | 713 | 5159 | 4828 | 4734 |
| Springfield, Missouri (A) | 606 | 620 | 632 | 4358 | 4077 | 4256 |
| Syracuse, New York (A) | 1123 | 970 | 955 | 6130 | 5761 | 5637 |
| Tacoma, Washington (C) | 672 | 741 | 595 | 4209 | 3761 | 3878 |
| Toledo, Ohio (A) | 961 | 869 | 905 | 5838 | 5307 | 5522 |
| Topeka, Kansas (C) | 632 | 702 | 669 | 4795 | 4401 | 4499 |
| Trenton, New Jersey (C) | 832 | 703 | 735 | 4639 | 4418 | 4495 |
| Tulsa, Oklahoma (A) | 429 | 461 | 485 | 3491 | 3098 | 3367 |
| Utica, New York (O) | 1141 | 1021 | 989** | 6337 | 6148 | 5955** |
| Valentine, Nebraska (A) | 980 | 1041 | 970 | 6909 | 6030 | 6140 |
| Walla Walla, Washington (C) | 612 | 748 | 564 | 4889 | 4269 | 4301 |
| Washington, D. C. (C) | 655 | 526 | 606 | 3964 | 3816 | 3864 |
| Wichita, Kansas (A) | 602 | 654 | 619 | 4460 | 4042 | 4183 |
| Williston, North Dakota (C) | 1194 | 1359 | 1194 | 8582 | 7347 | 7836 |
| Winnemucca, Nevada (A) | 813 | 855 | 794 | 5430 | 6077 | 5396 |
| Yakima, Washington (A) | 753 | 858 | 660 | 6068 | 4166 | 5172 |

For footnotes, see page 144.

## For HEATING, VENTILATING and AIR CONDITIONING

# NEW...

# WESTINGHOUSE AIR HANDLING COMBINATION UNITS in 13 basic sizes give you Unlimited Selection...

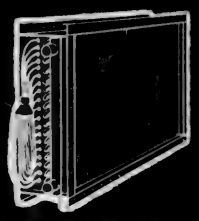
**The most complete line for every job—Westinghouse Air Handling Combination Units handle from 500 to 48,500 CFM.**

These versatile units, each with a choice of two coil face areas; in five coil types (see panel at right) and accessories as required, permit you to select from the broadest line in the industry.

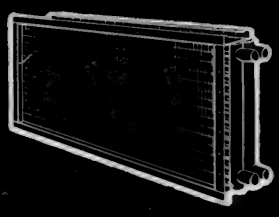
**Only Westinghouse Gives You:**

- High Efficiency
- Quiet Operation
- Non-Pulsating Air Flow
- Corrosion-Resistant Construction
- High Capacity—Low Resistance Coils
- Single Equipment Warranty

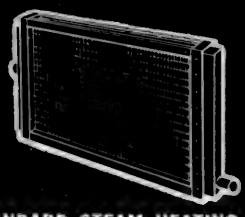
For complete application service, call your Consulting Engineer or your nearest Sturtevant Division Sales Engineer . . . or write Westinghouse Electric Corporation, Sturtevant Division, Department 15E, Hyde Park, Boston 36, Mass.



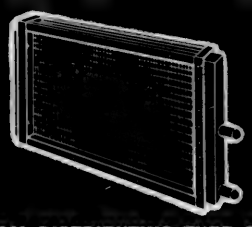
**DIRECT EXPANSION FOR COOLING AND DEHUMIDIFYING** . . . 4 5 and 6 rows deep.



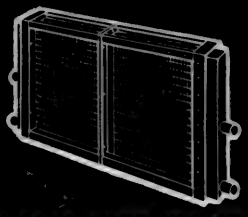
**WATER COILS** . . . for heating, cooling and dehumidifying—2 through 8 rows deep.



**STANDARD STEAM HEATING COILS** . . . for use with modulating damper control—1 and 2 rows deep with 3 fin spacings.



**STEAM DISTRIBUTING TUBE COILS** . . . for use with modulating steam valve control—1 and 2 rows deep with 3 fin spacings.



**DUAL FEED STEAM DISTRIBUTING TUBE COILS** . . . available in fin tube lengths—78 through 120 in.—1 and 2 rows deep with 3 fin spacings operates as two coils in single casing—supply and condensate connections at each end—eliminates stratification.

# WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE...IF IT'S Westinghouse

J-80891

# NEWS OF THE MONTH

## CONSTRUCTION CONTRACTS

**awarded in March soar to record highs for eastern states. Residential awards are highest in history.**

Contract awards for future construction in the 37 eastern states soared to $2.382 million in March, according to F. W. Dodge Corporation.

• **NEW RECORDS SET.**—Several new records were set by the March figures: (1) The total was the highest for any March in history, 12% above March of last year;

(2) It was the scond highest total for any month in history, exceeded only by May, 1951, when atomic energy contracts of nearly a billion dollars were let. If atomic energy contracts are excluded, March, 1956, was by far the highest month;

(3) Residential awards in March were the highest for any month in history, and the total of $1.105 million was 12% ahead of March, 1955;

(4) The first quarter of 1956 set new all-time records for total contract awards and for each major category—residential, non-residential and heavy engineering.

Other details: March non-residential building was up 16% over March, 1955, at $881 million. First quarter 1956 totals compared with the same period for 1955 were: Total construction, up 17%; non-residential, up 17%; residential, up 8%; and heavy engineering, up 42%.

## INDUSTRIAL CONTRACTOR

**cloaks a 90-ft quenching chimney in an effort to complete construction despite severe winter storms.**

In order to meet a tight building schedule at Lorain, Ohio, which could not be stalled by bad weather, The M. W. Kellog Company cloaked a 90-ft brick chimney it was constructing with a draw-string cover.

Sheltering workmen as well as materials, the Neoprene-coated, Nylon tarpaulin was held against the brickwork and an interior skeletal framework by draw-strings at the top and bottom and moved upwards as building progressed. This permitted the installation of heating and lighting units so that the work force was able to build approximately eight to nine feet of brickwork at a stretch in relative comfort.

• **STORMS.**—During construction, from January 15th to March 15th, there were twenty-six days of below freezing temperatures ranging from 30 degrees down to 9 degrees. Rain, sleet, or snow fell a total of eighteen days, and the area was hit with one of the most severe winter storms in its history. The protection afforded by the tarpaulin permitted construction to proceed with the loss of only one working day, and that was when wind velocities exceeded 85 mph.

The 90-ft quenching chimney, approximately twenty-two feet in diameter at the bottom and seventeen feet at the top, was constructed for National Tube Company's coke plant. The general contractor was The Koppers Company of Pittsburgh, Pa.

## PLAN TO MERGE

**York Corp. with Borg-Warner is approved by companies' directors. Part of diversification program.**

Directors of Borg-Warner Corporation and York Corporation have unanimously approved a merger of the two companies.

• **EXCHANGE YORK SHARES.**—Under a reorganization plan Borg-Warner will succeed to all of the assets and assume all of the liabilities of York. Each York common shareholder will receive one-half of one share of Borg-Warner common stock for each share of York common stock. In addition, the York common shareholders would receive $2 in cash for each share of York common stock.

Recommendations for the affiliation were submitted to the two companies' directors by Roy C. Ingersoll, chairman and president of Borg-Warner, and Stewart E. Lauer, president of York. Mr. Lauer will recommend that the York shareholders approve the reorganization plan at a special meeting to be held in June. The plan is also subject to the approval of the requisite federal authorities.

• **DIVERSIFICATION PROGRAM.**—Mr. Ingersoll said that the merger is a part of Borg-Warner's program of diversification. When it becomes effective, York will be operated as a separate division. Both Mr. Lauer and Mr. Ingersoll felt that the distribution and expansion of products would be greatly enhanced by the affiliation of the two companies.

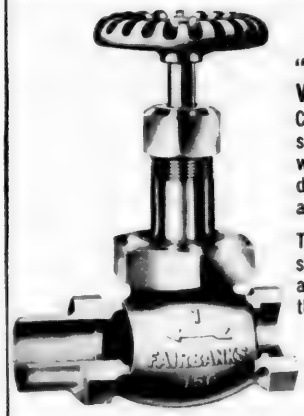
Borg-Warner's 1955 sales in diversified fields, including home appliances, automotive components, farm equipment, aircraft parts, oil field equipment, steel and plastics, totaled $552,192,430 with net earnings of $41,075,784. York's 1955 sales, including commercial and domestic air conditioning, commercial refrigeration systems and allied lines, were $82,713,623 and net earnings $2,426,236.

*(News continued on page 150)*

insure [illegible] brazed joints

Fairbanks THREADLESS Valves

in copper or brass piping



**"Fairco-Braze" Threadless Valves for silver brazed joints.** Cut costs, speed installation of piping systems handling steam, hot or cold water, oil, compressed air, carbon dioxide, Freon and many other liquids and gases.

The silver brazed connection withstands tension, compression, torsion and vibration to a far greater degree than any other type joint.

**Solder End Threadless Valves for soldered joints.** Get perfect seal of valves for type "K", "L" and "M" copper tubing with Fairbanks Solder End Threadless Valves. Simple, quick installation provides a smooth, compact, full flow assembly that has high resistance to corrosion.

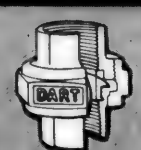
Full line of Fairbanks Solder End Threadless Valves—Globes, Gates and Checks—have an unusually wide application range.

**YOURS ON REQUEST:** Fairbanks Valves Catalog, complete with cutaways, details, and specifications describing these Fairbanks Threadless Valves.

THE Fairbanks COMPANY
393 LAFAYETTE STREET
NEW YORK 3, N. Y.

BRANCHES:
NEW YORK 3 • BOSTON 10
PITTSBURGH 22 • ROME, GA.

VALVES
TRUCKS
CASTERS
DART & PIC UNIONS




# dorex SNIFFS TROUBLE SNUFFS IT OUT

● A maker of fine photographic printing papers was plagued by intermittent spoilage—evidently caused by some airborne impurity too dilute to be identified by any means of analysis at hand.

Connor engineers were called in as experts on air purification. They installed Dorex test equipment to determine the nature of the impurity. Later, these test units were analyzed in the Connor laboratory—revealing the cause of spoilage as minute quantities of phosphorus originating from a smelter some miles away

As a result of these findings, Dorex Air Recovery "C" Cells were installed in the air conditioning system—and the spoilage stopped immediately.

This is one example of how Dorex Air Recovery can purify outside air for sensitive manufacturing operations. Equally important is the positive indoor protection Dorex can provide in areas where smog is a problem.

Special cases aside, Dorex Air Recovery in any air conditioning or ventilating system will substantially reduce (1) the needed amount of outside air, (2) the needed capacity for heating and cooling, (3) installation and operating costs. Write us for full information, Connor Engineering Corporation, Dept. B-56, Danbury, Connecticut.

CONNOR ENGINEERING CORPORATION
dorex®
air recovery

(*Continued from page* 148)

## TECHNICAL CONFERENCE

**to discuss research activities in warm air heating and air conditioning. Meeting to serve as industry forum.**

The National Warm Air Heating and Air Conditioning Association has released the tentative program planned for its first Annual Technical Conference, scheduled to be held Thursday and Friday, May 24th and 25th, 1956, at the Edgewater Beach Hotel, in Chicago.

Planned for the purpose of establishing a forum in which the technical men of the industry can gather and exchange information pertinent to residential heating and cooling systems and equipment both now and in the future, the conference will include the following in its program: heat gain in air conditioning ducts, pressure losses in fittings and diffusers, system balancing for year-round air conditioning in one and two-story residences, nuclear energy, solar energy, and others.

• **OPEN TO INDUSTRY.**—Conference attendance is open to open to all industry members. The Association has made advance registration arrangements whereby those who register will be provided with abstracts of the papers for study prior to the conference. Registration fees are: $20.00 for Association members, and $30.00 for non-members. The fees include the cost of luncheons held during the two conference days.

## BUILDING RESEARCH INSTITUTE

**will hold 5th Annual Meeting at Niagara Falls, Ont. Plan six technical sessions and home design panel.**

The Fifth Annual Meeting of the Building Research Institute, to be held May 20 to 22 in the Sheraton-Brock Hotel, Niagara Falls, Ontario, will present a two-day technical program with sessions on residential community construction, adhesives in building, what's new in plumbing, standard steel buildings, particle board products, a report on FHA's technical program, and a featured panel on home design.

The meeting will open Sunday May 20 with an afternoon reception. There will be a dinner for the Board of Governors Sunday evening, followed by a business meeting. Monday evening's highlight will be the Annual Institute Dinner to be followed by the featured panel. Research laboratory tours, sightseeing tours, and a special ladies' program round out the scheduled events.

• **PANEL.**—James M. Lange, executive editor of Practical Builder magazine, will moderate the panel on What Mrs. America Wants in Tomorrow's Home. Panel members are: Edith Brazwell Evans, editor-in-chief, Living for Young Homemakers magazine; Esther Foley, home service editor, True Story magazine; and Annabelle F. Heath, assistant administrator, Housing and Home Finance Agency.

• **TECHNICAL.**—The Residential Community Construction session will have topflight experts on all aspects of building homes, shopping centers, and communities on the biggest scale.

A research authority, a manufacturer, and a technical expert for prefabricators, will critically examine research and new developments in plumbing for buildings and houses on the session, What's New in Plumbing.

A discussion on new uses, products and methods from a new field of building technology will highlight Adhesives in Building, with Professor Albert G. H. Dietz of M.I.T. and a panel of Building Research Institute experts.

FHA's Technical Program will be presented by Neil H. Connor, Director of the FHA Architectural Standards Division.

Particle Boards—Their Manufacture and Uses will be reported by Carl A. Rishell, Vice President of the Timber Engineering Company.

Standard Steel Buildings will be presented by Wilbur B. Larkin, Steel Building Division Manager, Butler Manufacturing Company, and R. Blickensderfer, Adviser Engineer for Building Products of Armco Steel Corporation.

## REFRIGERATING ENGINEERS

**52nd Annual Meeting set for June 4 to 6 in Cincinnati. Program covers design and air conditioning.**

The 52nd Annual Meeting of The American Society of Refrigerating Engineers will be held June 4-6 at the Hotel Sheraton-Gibson in Cincinnati.

Some 700 delegates, guests and other representatives of the air conditioning and refrigeration industries in the United States and Canada are expected to attend.

Installation of newly-elected officers, technical sessions and conferences, forums, symposiums, social, cultural and educational activities are on the meeting agenda.

• **OFFICERS.**—C. M. Ashley, chief staff engineer for Carrier Corp., Syracuse, N. Y., will be installed as president at a welcome luncheon on June 4. Other officers to be installed are H. F. Spoehrer, vice president and treasurer of Sporlan Valve Co., St. Louis, first vice president; Cecil Boling, president of Bush Mfg. Co., West Hartford, Conn., second vice president, and D. D. Wile, vice president of Refrigeration Engineering Inc., Los Angeles, treasurer.

• **PROGRAM.**—The tentative program schedule planned by E. P. Palmatier, program chairman follows:

*June 4, Monday A. M.—First Technical Session*

Factors Considered in Hermetic Motor Design, by R. F. Munier, consulting engineer, Emerson Electric Mfg. Co., St. Louis, Mo.

Use of Dissimilar Metals in Refrigeration and Air Conditioning Equipment, by J. F. Mason, Jr., corrosion engineer, International Nickel Inc., New York, N. Y.

A new Instrument for the Moisture Analysis of Freon Fluorinated Hydrocarbons, by E. S. Taylor, service engineer, E. I. du Ponte de Nemours Inc., Wilmington, Del.

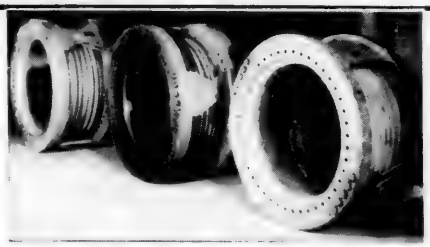
In addition, there will be conferences Monday on Frozen foods and proposed industry research.

*June 5, Tuesday A. M.—Second Technical Session*

Cross-Flow Cooling Towers, by S. M. Zivi, research engineer, Midwest Research Institute, Kansas City, Mo., and Bruce B. Brand, Havens Structural Steel.

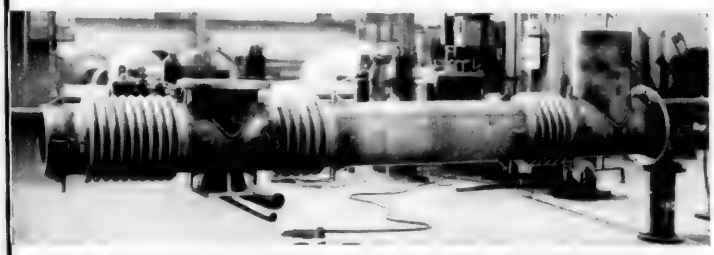
(*Continued on page* 152)

# ADSCO



*Three 48" Hinge-Type Corruflex Expansion Joints*

## ENGINEERING BACKS UP EVERY CORRUFLEX PACKLESS EXPANSION JOINT

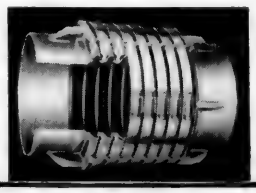


*Complex stainless steel assembly of piping and joints absorbing four different motions*

Regardless of size or degree of complexity of the joint involved, ADSCO applies its vast engineering experience to every piping problem presented to it. The help ADSCO provides not only makes the customer's piping react the way it should but also saves money in both installation and maintenance costs. Next time consult ADSCO, a leader in the development of maintenance-free packless expansion joints.

• *Write for Bulletin 35-51.*

*Basic Corruflex Joint with Equalizing Rings*



AMERICAN DISTRICT STEAM DIVISION
ADSCO INDUSTRIES, INC.
20 MILBURN ST. BUFFALO 12, N. Y.

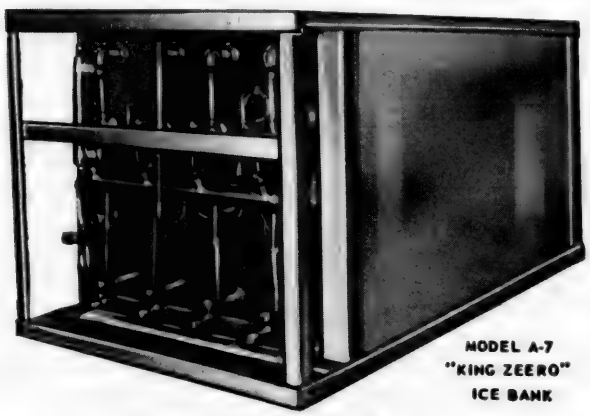
## "King Zeero's" Sweet Water ICE BANKS offer ICE-CONCENTRATED Refrigeration for Air Conditioning

**CONTINUOUS RIFLED GALVANIZED COILS EXPANSION VALVE CONTROLLED**

**32°-34° COLD ICE WATER**

**DESIGNED FOR USE WITH: FREON — METHYL CHLORIDE — AMMONIA**

The "King Zeero" ICE BANK is designed for air cooling in Churches, Mortuaries, Theatres, Offices, Stores, Auditoriums, Factories, Clubs, Restaurants, etc. Ice Banks may be added to existing systems for increased capacity.



MODEL A-7 "KING ZEERO" ICE BANK

The "King Zeero" ICE BANK is designed to deliver tons of 32 to 34 F. ice water for recirculation through air cooling coils. Peak loads many times compressor capacity are easily handled.

- DIRECTED COURSE OF WATER travels with "built-in" agitation.
- NO MECHANICAL AGITATION REQUIRED.
- LARGE WATER COMPARTMENTS spaced on 11" and 12" centers.
- 33% EXTRA ICE CAPACITY safely attained without freezing up.
- ICE IS "BURNED OFF" PLATE COILS progressively, exposing prime and secondary surface for maximum flash cooling capacity.
- ICE THICKNESS automatically controlled - eliminates "freeze ups."
- 94 SIZES to fit space requirements. Other designs for special applications.

CAPACITIES - 500 lbs. to 30,000 lbs. (72,000 B.T.U.'s to 4,320,000 B.T.U.'s) in a single unit. Multiple units may be installed.

**MAIL COUPON TODAY**

King Zeero Co., 4302 W. Montrose Ave., Chicago 41, Ill

☐ Please send me your new ICE BANK Catalog.

Name _____

Address _____

City _____ State _____

THE KING ZEERO COMPANY
4300-14 W. Montrose Ave., Chicago 41, Ill.

## REFRIGERATING ENGINEERS

(*Continued from page* 150)

Reduction of Total Solids by Deionization, by Professor W. A. Cunningham, University of Texas, and W. C. Mills, Olin Mathieson Chemical Co., Brandenburg, Ky.

High Radiopasteurization as a New Food Process, by L. E. Brownell, supervisor of Fission Products Laboratory, University of Michigan, and S. N. Purohit, University of Michigan graduate student.

Concurrently, there will be a domestic refrigerator engineering conference.

*June 5, Tuesday P. M.—Six Technical Forums:*

Sponsored by ASRE General Technical Committee Vice Chairman Robert H. Tull, manager, refrigeration specialties engineering, Westinghouse Electric Corp., Springfield, Mass. will be completely unrecorded open discussions on: (1) Corrosion Problems of Blower Equipment, (2) Methods of Rating and Testing Transportation Refrigerating Equipment, (3) Leak Testing Methods and Equipment, (4) Contaminants in Refrigerating Systems, (5) What Value Suction Line Heat Exchangers, (6) Central Air Conditioning vs. Room Air Conditioners for Apartment Houses.

*June 6, Wednesday A. M.—Third Technical Session*

Temperaure Changes in Refrigerated Rooms During Pull-Down Period, by Professor J. L. Threlkeld, University of Minnesota, and Tamami Kusuda, research engineer, Worthington Corp., Newark, N. J.

At Last—A Practical Heat Pump, by R. G. Werden, industrial sales manager, York Corp., Philadelphia, Pa.

Turbulent Flow of Air Through Capillary Tubes, by F. G. Smith, (retired), American Brass Co., Waterbury, Conn.

A concurrent air conditioning conference will cover the subject, Packaged Commercial Units, moderated by Chairman R. A. Gonzalez, director of application-engineering and sales training, Chrysler Corp., Airtemp Division, Dayton, Ohio.

Selection Considerations Between Packaged Air Conditioners and Central Station Equipment for Large Spaces, by F. C. Wood, York Corp., Atlanta, Ga.

New Field Application Problems for Air Cooled Condensing Equipment, by M. D. Irwin, Carrier Corp., Syracuse, N. Y.

Condensing Surface and Air Quantities for Integral Horsepower Air Cooled Air Conditioning Equipment, by J. R. Neuhoff, Central Electric Co., Bloomfield, N. J.

Compressor Unit Design Considerations for Air Cooled Condensing Equipment, by P. W. Wyckoff, Chrysler Corp., Airtemp Division, Dayton, Ohio.

## GAS HEATS 15.4 MILLION HOMES

**according to AGA, reporting on a survey of gas utilities. Expect to add 3.8 million in next 3 years.**

Gas heat installations made during the 1955-56 heating season totaled 1,439,000, the American Gas Association reports. Gas utilities expect to add more than 3.8 million new installations during the next three heating seasons, which would bring the total number of gas-heated homes to 19.2 million by December, 1958. At the end of 1955 there were 15.4 million homes heated by gas, equivalent to 57.5% of all residential gas customers, according to AGA.

Existing gas househeating customers represented 69.2% of all residential users considered to be part of the potential market for gas househeating.

• **LOCATION OF GAINS.**—The East North Central states are expected to show the most significant gains during the next three heating seasons, where approximately 1,035,000 new heating customers will be added. This would represent a gain of about 38% in gas heat customers in that area for the three years. In the Middle Atlantic states, additions of 490,000 gas househeating customers are expected during this same period, increasing heating customers by 28%. New gas heating installations in the New England area are estimated to aggregate 134,000 units, an increase of 85% over the 158,000 homes presently gas heated in this region.

(*Continued on page* 154)

**GAS HOUSEHEATING INSTALLATIONS IN THE U.S.**

| | Estimated Gas Househeating Customers, in Thousands, As of December 31, 1955 |
|---|---|
| United States Total | 15,430 |
| New England | 165 |
| Connecticut | 34 |
| Maine | 2 |
| Massachusetts | 106 |
| New Hampshire | 9 |
| Rhode Island | 14 |
| Vermont | * |
| Middle Atlantic | 1,781 |
| New Jersey | 208 |
| New York | 656 |
| Pennsylvania | 917 |
| East North Central | 2,851 |
| Illinois | 601 |
| Indiana | 195 |
| Michigan | 571 |
| Ohio | 1,366 |
| Wisconsin | 118 |
| West North Central | 1,517 |
| Iowa | 227 |
| Kansas | 414 |
| Minnesota | 249 |
| Missouri | 402 |
| Nebraska | 174 |
| North Dakota | 16 |
| South Dakota | 35 |
| South Atlantic | 1,131 |
| Delaware | 8 |
| District of Columbia | 63 |
| Florida | 133 |
| Georgia | 317 |
| Maryland | 176 |
| North Carolina | 34 |
| South Carolina | 15 |
| Virginia | 120 |
| West Virginia | 265 |
| East South Central | 828 |
| Alabama | 220 |
| Kentucky | 239 |
| Mississippi | 198 |
| Tennessee | 171 |
| West South Central | 2,936 |
| Arkansas | 211 |
| Louisiana | 510 |
| Oklahoma | 484 |
| Texas | 1,731 |
| Mountain | 780 |
| Arizona | 191 |
| Colorado | 234 |
| Idaho | * |
| Montana | 83 |
| Nevada | 8 |
| New Mexico | 124 |
| Utah | 95 |
| Wyoming | 45 |
| Pacific | 3,441 |
| California | 3,403 |
| Oregon | 27 |
| Washington | 11 |

*Less than 500 customers.

# STAINLESS STEEL COMBUSTION CHAMBER OF THE OLSON

**MOST ADVANCED HEATER**

The combustion chamber of an Olson is constructed of Austinetic Stainless Steel. Its floating design eliminates undue expansion and contraction stresses. Note the secondary heat transfer surface above, a multiple battery of 10 guage boiler tubes separated by stainless steel baffles providing a four pass counterflow gas travel. The extended flue gas travel and extra heat transfer surface insures high efficiency and safe metal temperatures and long dependable heater life. Write for complete information on Olson Heaters.

Olson

**STAINLESS STEEL DIRECT FIRED HEATERS**

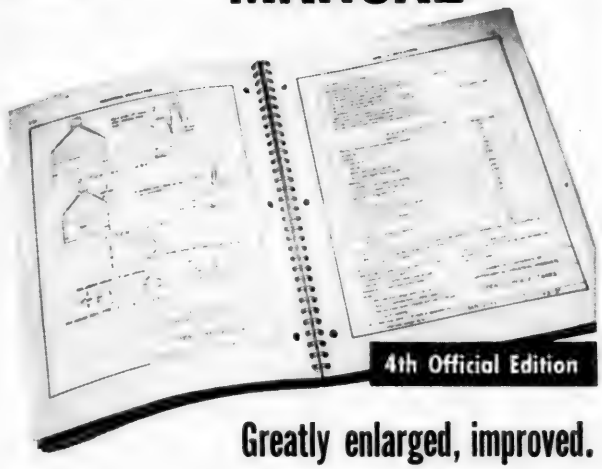
Gas—Oil—Dual Gas and Oil—300,000 to 2,000,000 BTU

**CANFIELD, OHIO**

REPRESENTATIVES IN PRINCIPAL CITIES



# *New!* VENTILATION MANUAL




**Greatly enlarged, improved. Many new tables on industrial ventilation.**

Here's the latest edition of the authoritative Industrial Ventilation Manual—written by practicing field engineers. It's bigger, better . . . includes simple application drawings on most industrial ventilation operations. Invaluable to engineers and sheet metal fabricators.

Take a look at some of the many subjects in this year's edition:

| | |
|---|---|
| **Dilution Ventilation** | **Make-up and Recirculated Air** |
| **Comfort Ventilation** | **Construction Specifications** |
| **Hood Design** | **Testing of Ventilation Systems** |
| **Specific Operations** | **Fans** |
| **Duct Design** | **Air Cleaning Devices** |

The Ventilation Manual is the official publication of the American Conference of Governmental Industrial Hygienists and is used as a basic text by many leading universities. It contains all the information needed for the complete design of industrial ventilation systems. The recommended ventilation practices are approved by Federal, State, and Municipal Government Industrial Hygiene Departments.

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Enclosed please find $_____ for _____ copies of the new 4th edition of the Industrial Ventilation Manual.

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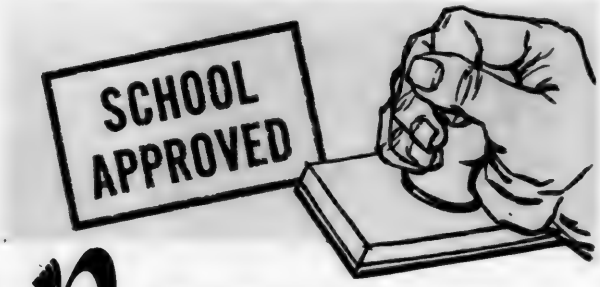
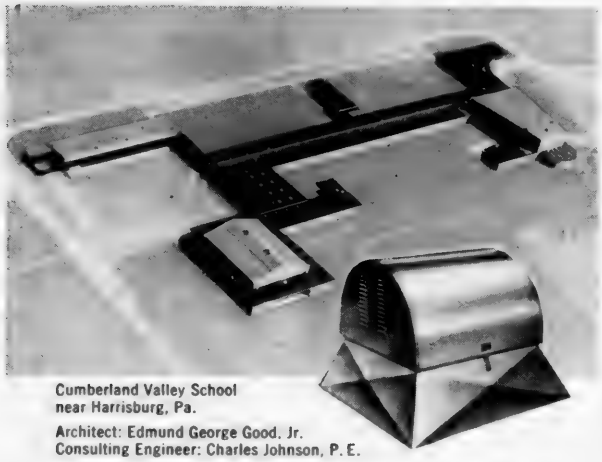



SPECIFIED AGAIN . .

PENN VENTILATORS

*make school ventilation problems elementary*



Cumberland Valley School
near Harrisburg, Pa.
Architect: Edmund George Good, Jr.
Consulting Engineer: Charles Johnson, P. E.

**Penn Ventilators have been used for the ventilation of countless schools. Design problems become easy as ABC when these versatile quiet exhausters are incorporated with interior duct systems . . or for general spot ventilation.**

**Penn Ventilators are styled low and attractively blend with modern architecture. The Penn Ventilator man in your area has complete details . . you would do well to contact him soon.**

***Penn's 3 R's of Ventilation . . .***
***Results and Reliability through Research***

PENN VENTILATOR CO.

PHILADELPHIA 40, PA.

**Representatives and Distributors in Principal Cities**
**Member of the Power Fan Manufacturers Association**

In Eastern Canada: **Air-Care, Ltd.**
2125 Marcil Ave., Montreal 28, Que.




## GAS HEATS 15.4 MILLION HOMES

(*Continued from page* 152)

New home construction during the next three heating seasons will account for 62% of the new gas heating installations, with the remainder representing conversions of existing homes. Anticipated continuation of high new construction levels holds promise for the maintenance of significant new additions to gas heating customers. Conversions from other forms of heating continue substantially to exceed new home installations in both New England and East North Central regions.

As of October 31, 1955, there were 72 utilities, serving 6.7 million residential customers (equivalent to about 25% of all households served by the gas industry) which still had in effect some restrictions of new heating installations. Two years ago there were 88 utilities, serving 9.1 million families, which were in a similar position. Increasing supplies of gas and greater utilization of underground storage facilities have been responsible for this improvement. It is expected that the frequency of restrictions will be further reduced in the near future.

## BENEFITS OF COOLING

**are revealed by survey of air conditioned homes. Results range from better appetites to less dirt.**

A survey recently conducted by Worthington Corporation discloses that people living in air conditioned homes feel better, sleep better, and have more time and energy to spare. The company queried a cross-section of homeowners in whose homes one of its residential year-round units was installed with the purpose of discovering what added benefits air conditioned living has to offer. The homeowners surveyed reside in twenty-three of the forty-eight states.

• **RESULTS.**—Of the homeowners surveyed, 40% responded, and here are some of the results shown in percentages based on the number who responded.

63% reported improved appetites among individual members of the family.

75% serve more hot meals in the summer.

58% reported an improvement in the dispositions of individual members of the family.

43% reported they have more recreation time on their hands.

63% reported they have more energy.

65% reported an improvement in the general health of the family.

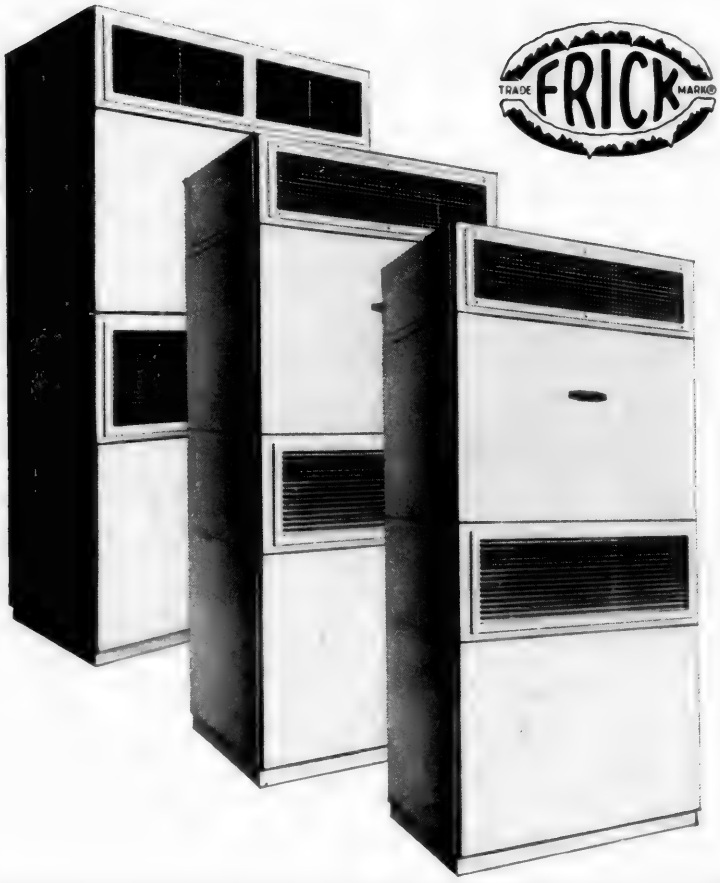
40% say they suffer from less colds than before.

48% reported less suffering from alergies, asthma, and sinus conditions. (One homeowner commented that air conditioned living helped alleviate hay fever suffering; another said it eliminated prickly heat, so prevalent in summer months.)

75% reported street noises were less noticeable.

65% reported dusting time definitely cut down from

(*Continued on page* 156)



TRADE FRICK MARK®

# Unit Air Conditioners

Have built into them 50 years' experience in conditioning air, 74 years' experience in refrigeration, and 103 years of successful engineering. Frick unit air conditioners installed in 1938 are still in service — and good for a long time to come.

These superior units are furnished in sizes of 3, 5 and 7½ hp. They have heavier (quieter) cabinets, well insulated; larger cooling surfaces; insulated condensers; conservative ratings; and many other advantages. All are shown in Bulletin 522. Your copy is waiting: write today.

Some desirable territories still open for qualified Distributors.

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.

---

BISON

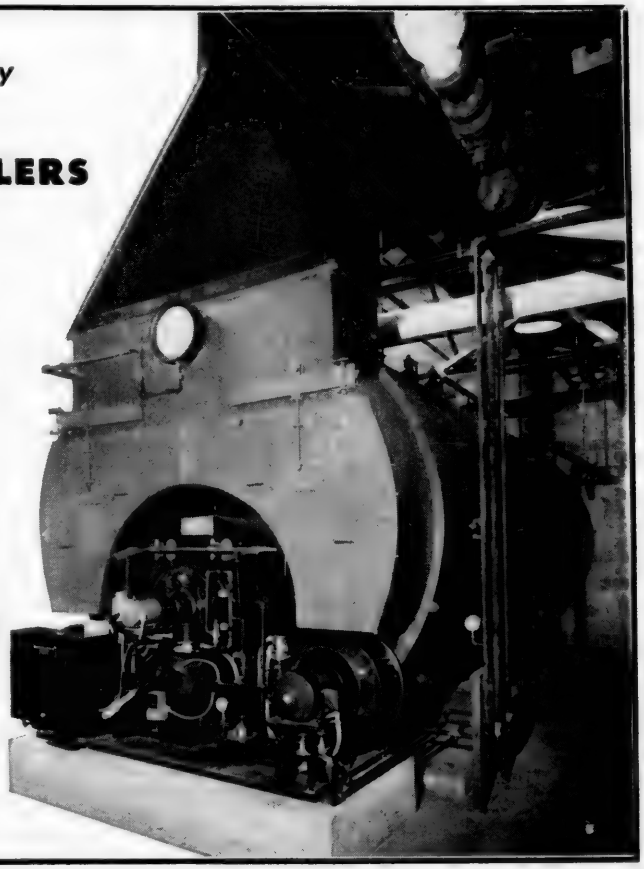
***Dependable quality since 1863 . . . . .***

## POWER BOILERS

Throughout 93 years, Farrar & Trefts has been a leader in boiler design and construction. Today, as in yesteryear, F & T offers dependable, efficient, modern power boilers to satisfy the ever-increasing demands of institutional, apartment, office and industrial buildings. Under the same BISON brand, F & T also furnishes low-pressure boilers for heating purposes.

Proper selection of a boiler for the continuous delivery of required heat and power is a precise project, demanding the systematic approach of engineers long trained in this work. Engineers at F & T have this background of service and they welcome opportunities to evaluate the needs of boiler users.

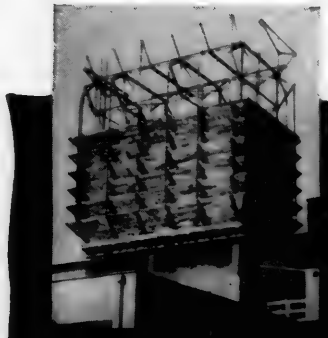
*Standard F & T Super Scot Power Boiler (150 lb. design pressure) with "Indiana Pack" burner at Mastic Asphalt Corp., South Bend, Ind. Furnished by Page Associates of Chicago. The Austin Co. were the Engineers and Contractors.*



FARRAR & TREFTS DIVISION

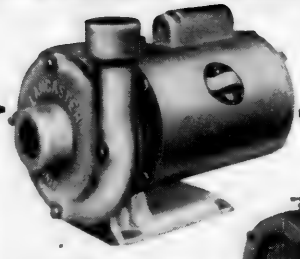
ADSCO INDUSTRIES, INC.

20 MILBURN ST. BUFFALO 12, N. Y.



For All Air Conditioning and Refrigeration Installations

LANCASTER
UNIT PUMPS TYPE M
Low Cost, High Quality
Close-Coupled Centrifugal Pumps



▶ Quiet Operation
▶ Balanced Bronze Impellers
▶ Bronze Shaft Coupling
▶ Easy to Install
▶ Four Position Indexing
▶ Ceramic Seat Mechanical Seals

LANCASTER Unit Pumps Type M are specifically designed for Air Conditioning and Refrigeration systems wherever a reliable and dependable close-coupled Centrifugal Pump is required. They are ideal for cooling tower systems as well as brine and other liquid circulation.

All LANCASTER Unit Pumps are designed for continuous duty and are equipped with the latest type ceramic seat seals. Heavy duty models are available from ⅛ to 7½ HP. They are also well suited for general purpose industrial applications.

You can use Submersibles for modern and convenient deep well cooling in your air conditioning systems. Be sure to find out about the complete line of LANCASTER Underwater Pumps from ⅓ HP to 275 HP equipped with reliable 100% water cooled, water lubricated, and water filled motors.

*Write for latest catalog.*

LANCASTER pumps
LANCASTER PUMP & MANUFACTURING CO., Inc.
Box K-778, Lancaster, Pa.



## BENEFITS OF COOLING

(*Continued from page* 154)

daily to weekly, and from daily to only two or three times per week.

40% reported use of vacuum cleaner changed from semi-weekly to weekly and weekly to two or three weeks.

One family reported a $50 a year saving in rug cleaning; three families reported they saved on drapery and slipcover cleaning—one saved $50; another $15; and the third, $60. One family reported they saved $100 on the cleaning of clothes.

• **COSTS.**—Operating costs varied considerably, depending upon location, type and size of home, shading, insulation, and the number of hours the unit was operating. These are the average operating costs for cooling per year indicated by the answers in the survey: Southwestern area, $137.75; Southern area, $73.33; Southeastern area, $119.00; Eastern area, $87.50; Central area, $93.00; and Western area, $87.50.

## PLUMBING GROUPS

**merge to form single organization of brass manufacturers to represent the industry. Program is adopted.**

Thirty manufacturers of plumbing brass met in Cleveland, Ohio, recently to organize the Plumbing Brass Institute, an all-industry association resulting from the merger of the Sanitary Brass Institute, the Tubular Brass Goods Institute, and the Brass Gas Stop Institute.

The newly elected officers of the Institute are: A. H. Goepel, Scovill Mfg. Co., president; G. L. Hartmann, Milwaukee Faucets, Inc., first vice-president; J. D. Clemens, Hays Mfg. Co., second vice-president; and M. C. Frost, Frost Co., treasurer. Hanson & Shea, Inc., Pittsburgh, Pa., will serve as secretary for the newly formed association.

• **PURPOSE.**—A. H. Goepel, newly elected president, pointed out that: "The Plumbing Brass Institute has been formed to provide a single association more representative of the plumbing brass industry. The Institute will provide a central organization through which the industry can carry on broader activities which will be beneficial to individual member companies."

The institute formed four product sections: rough cast plumbing brass, finished cast brass, tubular plumbing brass, and brass gas stops and iron body valves. The program adopted by the Institute includes the statistics of the industry, market analysis, labor reports, standards, and a public relations program.

### Hot Water Fuel Cost

Credit to the source of Table 4, Comparative Fuel Cost Chart for Commercial Water Heating, in last month's Reference Section, Design Data for Service Hot Water, was inadvertently omitted. The table was compiled by and presented through the courtesy of A. O. Smith Corp., Milwaukee, Wis.

# FREE CATALOG

**NEW!** A-J **1956 Edition!**

**Listing Over 1,000 Sizes and Designs of**

## REGISTERS • GRILLES • DIFFUSERS
## FOR HEATING and AIR CONDITIONING

Just off the press — the latest and biggest A-J Catalog — of Heating and Air Conditioning equipment. Here you will find listed every size and type of register, grille and diffuser you will need for any job. The most complete catalog we've ever published — 32 pages listing over 1,000 sizes and types of items. Many are exclusive patented A-J designs. You'll want this handy catalog and reference book. Write for it today! It's free — there's no charge or obligation.

**IF YOU USE OR SPECIFY ANY OF THESE ITEMS — YOU SHOULD HAVE THE NEW A-J CATALOG!**

- Dampers—Opposing Blade
- Diffusers—Double
- Diffusers—Single
- Extractors
- Grilles—Air Conditioning
- Grilles—Architectural
- Grilles—Door and Partition
- Grilles—Floor
- Grilles—Lightproof
- Grilles—No-Vision
- Grilles—Return Air
- Grilles—Thin Core
- Grilles—Ventilating
- Registers—Air Conditioning
- Registers—Floor
- Registers—Perimeter Diffusing
- Registers—Wall and Ceiling

## A-J MANUFACTURING CO.

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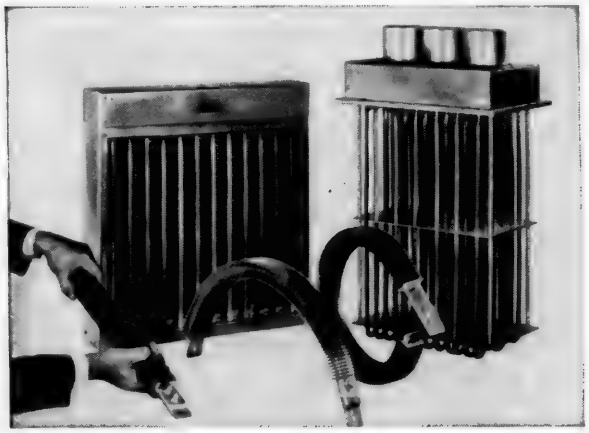

accurately controlled temperatures
to 1000°F easily maintained

## CHROMALOX *Electric* AIR DUCT HEATERS

are the modern, economical answer to your requirements for heating air and gases under forced circulation. Parallel fin design dissipates maximum heat with minimum turbulence of air stream.

Easily installed in round or rectangular ducts. Either manual or automatic thermostat control. Moisture-proof types available.

Used in ducts for drying, curing, baking and annealing ovens—there's a heater for any air flow or temperature rise.

**Let your Chromalox Sales-Engineering staff solve your heating problems...electrically**

**WRITE FOR YOUR COPY OF CATALOG 50**

—for full information on the complete line of Chromalox Electric Heaters and controls.

For ideas on additional applications of electric heat, request Booklet F1550—"101 Ways to Apply Electric Heat."

**Edwin L. Wiegand Company**

A 4468 7588 Thomas Boulevard, Pittsburgh 8, Pa.

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*Air Capacities from 550 to 65,000 CFM Belt and Direct Drive*

## MODULAR

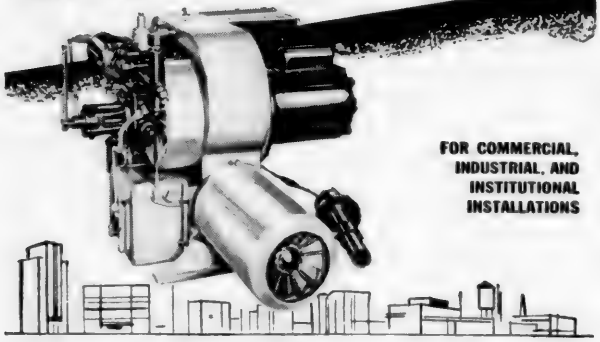
### POWER ROOF VENTILATORS

- Our new and complete line of power roof ventilators with their advanced modern design and new construction features fulfill today's architectural styling and job performance requirements.
- With MODULAR construction the following important features have been accomplished — low profile, maximum strength, maximum net free areas, complete resilient mounting with no metal-to-metal contact between the top cap and body, power section and body, and body to curb base.
- Seven top view sizes available from 30" x 30" overall, increasing by 6" increments to 66" x 66". Ventilator height varies in 5½" increments called the "MODULAR stack."
- Write for booklet that gives complete design, construction and performance data, and shows how to specify the correct Modular Roof Ventilator for maximum performance plus economy.

A few choice territories open for manufacturers' representatives

**ATMOS CORPORATION**
1215 W. Fullerton Ave.
Chicago 14, Ill.

# Hev-E-Oil Burner keeps heat cheap!



FOR COMMERCIAL, INDUSTRIAL, AND INSTITUTIONAL INSTALLATIONS

## Use heavy fuel oils *costing 30% less per gallon*

Cheap heat is smart economy! That's why thousands of owners are converting to Hev-E-Oil Burners and using *commercial* No. 4 or 5 heavy oils, costing 3 to 6¢ *less* per gallon than domestic light oils. Owners not only pocket the difference in cash, but get 7% more heat per gallon as well.

Hev-E-Oil Burners are specifically designed for heating buildings requiring more than 6,000 gallons of oil or 45 tons of coal per year.

Conversion is simple. The Hev-E-Oil fits all types of standard heating boilers and changeover takes only a few hours' time. Reports on file show fuel savings pay for conversion in a season or two.

**QUICK FACTS ON HEV-E-OIL BURNER**

- Automatic, all-electric ignition
- Flame size set exactly to furnace capacity
- Low-pressure, air-atomizing, with large, non-clogging nozzle
- Six sizes: 1 to 60 gph
- Built-in low fire start
- As simple to install as a domestic burner
- Easy servicing and cleaning
- Air and oil metered to give high efficiency

**If you own, specify, install or service** burners, get all the facts about Hev-E-Oil Burner — a *quality* product of America's leading manufacturer of self-contained boilers and oil-fired equipment. Write for illustrated Bulletin AD-102 NOW. CLEAVER-BROOKS COMPANY, Dept. F, 382 E. Keefe Ave., Milwaukee, Wis.

*Sales and Service In Principal Cities*

**Cleaver Brooks**

HEV-E-OIL BURNERS ARE DESIGNED TO SAVE YOU MONEY


# IN THE FIELD

**Sweiger-Davidson Co.** has been appointed sales representative in **Chicago** and the immediate trading area for **Kennard Corp.,** St. Louis. They will represent Kennard on their entire line of air conditioning products.

**T. D. Secord** has been appointed zone sales supervisor for **York Corporation's** Central District, with headquarters in Chicago. Mr. Secord will contact wholesale distributors of the company's room air conditioners in **Illinois, Michigan,** and **Wisconsin,** and he will assist them in acquiring and training dealers.

Three sales appointments announced by **McDonnell & Miller, Inc.,** are **Eugene Mitchell** and **James W. Platt** as regional sales managers, with headquarters at the company's home office in **Chicago,** and **Fred Rohe** as district manager for **Indiana** and **Western Kentucky**— the territory previously served by Mr. Platt. Mr. Rohe's office will be in Indianapolis, Ind.

**Connor Engineering** has appointed **John A. Sandberg,** Minneapolis, Minn., representative for the Kno-Draft, residential, ceiling air diffuser for **Wisconsin, Minnesota** and **North Dakota.**

**Minneapolis-Honeywell Regulator Company** has named **Frank Neal** western market manager for schools and will serve users in thirteen **Western, Mountain,** and **Southwestern states; Robert J. Hoefer** has been appointed branch commercial sales manager in Honeywell's **Cincinnati** office, and **Richard Beaubien** has been promoted to a similar post in **San Francisco.** The appointments are part of the company's program of field service to schools and commercial establishments.

**L. J. Wing Mfg. Co.,** Linden, N. J., announces the appointment of three sales representatives: **Power and Combustion, Inc.,** Baltimore, for much of the state of **Maryland; The Gulf-South Engineering Co.,** Birmingham, for **northern and central Alabama;** and **Bell & Co.,** Mobile, for **southern Alabama.**

**Airtemp Div., Chrysler Corp.,** is establishing a factory-owned distributorship in **New Orleans. C. M. Barr,** formerly New Orleans assistant regional manager, has been named manager of the firm, which will handle Airtemp's line of commercial and residential air conditioning and heating products. Engineering, parts, and service will also be included in the operation.

**Worthington Corp.** has appointed **Charles D. Cummins** district manager of its **Seattle** office. In his new capacity, Mr. Cummins succeeds E. D. Schivey, who has accepted a special assignment in the company's new Canadian operation. The Seattle district office maintains a branch office at Portland Ore., in the charge of Norman E. Wolfe, and a sales operation at Spokane under Harley M. Yake.

George L. Hickey, Jr. has been appointed sales representative in the New York metropolitan area for **Brunner Mfg. Co.,** Utica, N. Y., and **The Brunner Co.,** Gainesville, Ga. Mr. Hickey's duties will include contacts on applications of low temperature two-stage units and air conditioning units.

# RIGIDBILT

## PRODUCT COOLERS

Units available for any given temperature need, for both wet and dry operation. Water, and hot gas defrost can be furnished. Special problems needing custom engineered units are our specialty.

*FLOOR UNIT—(FLOODED AMMONIA)*
*Water Defrost*
*Others for all refrigerants and applications.*

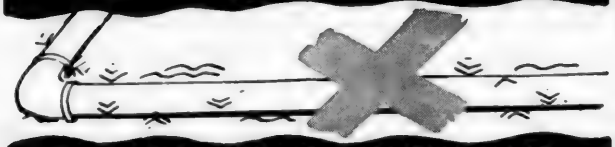
*RIGIDBILT IS BETTER BUILT*
*Write for Catalog*

**RIGIDBILT INC.**

2852 W. FULTON BLVD.
CHICAGO 12, ILL.

HEATING REFRIGERATION • AIR CONDITIONING

# ELIMINATE



# NOISY WATER HAMMER IN PIPE LINES

with

## Josam SHOCK ABSORBERS

The sudden pounding of water hammer can be disturbing almost *any* time, *any* place on *any* plumbing supply line in hospitals, hotels, institutions, homes, business and industrial plants and other establishments. Water hammer is not only annoying . . . it causes untold damage to valves, fittings and pipe lines. Water hammer disappears when you install Josam Shock Absorbers . . . they assure "hospital quiet" on all piping systems. For complete information, write for Manual "S" on Shock Absorbers.

**JOSAM MANUFACTURING COMPANY**
DEPT. HV MICHIGAN CITY, INDIANA

**North East** "Frankly, we've had no problem keeping busy. But I figured we could make out better and handle more jobs if we could find a line that would go in faster. We lost a lot of time waiting while other trades fitted openings to the valves or cabinets; also in placing or replacing glass. We tried Allenco. The cabinets fitted like custom-built; the glass went in in half the time. Allenco is like an extra man, without cost."

**South Midwest** "Our only problem in this field has been loss of men's time due to late delivery. When you're ready for fire-line valves or cabinets, and they're not there, you're wasting profit. I'd heard Allen wasn't fastest, but was reliable. That's true. You can bank on their delivery date. I know, now. In fact I bank *more,* now that I'm using Allenco."

**West Coast** "Our market is exceptionally cost-conscious. We got the habit of figuring the lowest-cost line. We got plenty of jobs, but our planned profit was eaten away by 'make goods.' We'd have to return and wait, or convert certain items on the job. Or cabinets would squeeze off-square. Then we began figuring on Allenco—sometimes it came a bit higher but we came out better. We still get all the work we can handle, and we net more with Allenco."

**26 Principal Cities** have Allenco branches. It will pay you to check with your Allenco man before you figure your next Interior Fire Protection job.

There's a reason why contractors prefer Allenco 3 to 2 over the next most popular line, why more buildings have Allenco than any other.

Look him up in your phone directory, or ask your wholesalers, or write direct to . . . W. D. Allen Manufacturing Co. – Allenco Building – Room 710 – Chicago 6, Illinois

With this new, sectional design Niagara condenser you avoid the many troubles due to faulty condensing and get at all times the full capacity your refrigerating plant should afford.

You benefit from extra saving in upkeep labor and expense. The casing of this new condenser is made of sections each separately removable, giving you access to all parts for easy inspection to head off dirt and corrosion, to clean the coils easily from either side.

You benefit from greater efficiency in condensing. A simpler method of using evaporative cooling improves heat transfer. You benefit from Niagara features that remove super-heat before condensing and keep the system purged of oil. You save 95% of the cooling water cost.

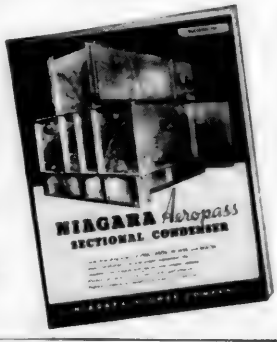
You benefit from a low first cost, lower freight cost and less expense in erection.

Capacity range is from 90 to 240 tons. Write for Niagara Bulletin 131. Find out how your plant can save expense this season.

**NIAGARA BLOWER COMPANY**

Dept. H. V., 405 Lexington Avenue
NEW YORK 17, N. Y.

*District Engineers in Principal Cities*




NIAGARA — *Over 40 Years' Service in Industrial Air Engineering*

**Canadian Degree Days for March, 1956***

| City | March | | Cumulative | |
|---|---|---|---|---|
| | 1956 | Normal | 1955-56 | Normal |
| Calgary, Alta. .... | 1272 | 1215 | 9400 | 7881 |
| Charlottown, P. E. I. | 1314 | 1203 | 6886 | 6869 |
| Crescent Valley, B. C. | 1060 | 961 | 7124 | 6704 |
| Edmonton, Alta. ... | 1366 | 1290 | 10048 | 8589 |
| Fort William, Ont. . | 1441 | 1386 | 8625 | 8590 |
| Grande Prairie, Alta. | 1418 | 1339 | 10919 | 8795 |
| Halifax, N. C. .... | 1148 | 1066 | 5936 | 6134 |
| London, Ont. ..... | 1149 | 1073 | 6416 | 6326 |
| Medicine Hat, Alta.. | 1226 | 1150 | 8966 | 7588 |
| Moncton, N. B. ... | 1327 | 1190 | 7235 | 7296 |
| Montreal, P. Q. ... | 1309 | 1265 | 7193 | 7373 |
| North Bay, Ont. ... | 1433 | 1280 | 8254 | 7933 |
| Ottawa, Ont. ..... | 1316 | 1256 | 7471 | 7638 |
| Penticton, B. C. ... | 901 | 787 | 6230 | 5566 |
| Prince George, B. C. | 1198 | 1091 | 9588 | 7768 |
| Quebec City, P. Q... | 1379 | 1311 | 7729 | 7999 |
| Regina, Sask. ..... | 1561 | 1504 | 10270 | 9641 |
| St. John, N. B. .... | 1321 | 1132 | 7011 | 6784 |
| Saskatoon, Sask. ... | 1588 | 1445 | 10549 | 9356 |
| Timmins, Ont. .... | 1626 | 1491 | 9198 | 9309 |
| Toronto, Ont. ..... | 1075 | 1072 | 5925 | 6226 |
| Vancouver, B. C. .. | 762 | 682 | 4935 | 4479 |
| Victoria, B. C. .... | 755 | 651 | 4832 | 4065 |
| Windsor, Ont. ..... | 1040 | 995 | 5815 | 5872 |
| Winnipeg, Man. ... | 1600 | 1531 | 9855 | 9622 |

*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

The Department reports a slight revision in the figures for February, as published in last month's issue. Corrected figure is: Victoria, B. C., 824.

# COMING EVENTS

**Where listed, names or titles of individuals are those from whom further information is available**

**STEEL BOILER MEETING**—Annual meeting of the Steel Boiler Institute, at the Brown Hotel, Louisville, Ky. R. A. Locke, secretary of the Institute, Land Title Building, Philadelphia 10, Pa. ..... **MAY 14-15, 1956.**

**DESIGN ENGINEERING SHOW**—First Design Engineering Show, held in conjunction with a conference on design engineering sponsored by the American Society of Mechanical Engineers, at Convention Hall, Philadelphia, Pa. Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. ..... **MAY 14-17, 1956.**

**MECHANICAL CONTRACTORS MEETING**—Annual meeting of The Mechanical Contractors Association of America (formerly, Heating, Piping and Air Conditioning Contractors National Association), at The Brown Hotel, Louisville, Ky. Secretary of the Association, 1250 Avenue of the Americas, New York 20, N. Y. ..... **MAY 15-18, 1956.**

**ADVANCEMENT OF MANAGEMENT CONFERENCE**—First National Material Handling Conference of the Society for Advancement of Management, at the Hotel Statler, New York, N. Y. Secretary of the Society, 74 Fifth Ave., New York 11, N. Y. ..... **MAY 17-18, 1956.**

**BUILDING RESEARCH MEETING**—Fifth annual meeting of the building Research Institute, at the Sheraton-Brock Hotel, Niagara Falls, Ontario. W. H. Scheick, executive director of the Institute, 2101 Constitution Ave., Washington 25, D. C. ..... **MAY 20-22, 1956.**

**AIR POLLUTION MEETING**—1956 Niagara Frontier annual meeting of the Air Pollution Control Association, in Buffalo, N. Y. H. C. Ballman, executive secretary of the Association, 4400 Fifth Ave., Pittsburgh 13, Pa. ..... **MAY 21-24, 1956.**

**TECHNICAL CONFERENCE**—First annual Technical Conference of the National Warm Air Heating and Air Conditioning Association, at the Edgewater Beach Hotel, Chicago, Ill. George Boeddener, secretary of the Association, 640 Engineers Building, Cleveland 14, Ohio. ..... **MAY 24-25, 1956.**

*(Concluded on page 162)*

# AIR CONDITIONING ENGINEERS

MARTIN. Developers of PROJECT VANGUARD, the EARTH SATELLITE vehicle, has challenging opportunities for engineers with air conditioning experience to work on high speed aircraft, rocket, and missile projects.

*Experience in one of the following fields desirable:*

HIGH AND LOW VELOCITY AIR OR LIQUID PIPING
SYSTEM PERFORMANCE
JET PUMPS — SEA LEVEL AND HIGH ALTITUDE
HEAT TRANSFER IN STRUCTURES
FANS

*Replies will be treated with confidence.*

Professional Employment Office

**MARTIN**

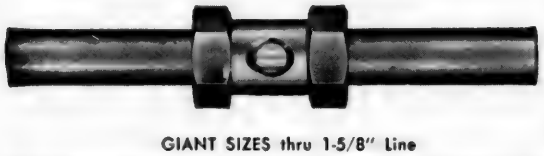
Baltimore 3, Maryland

# LIQUID EYE®

**POSITIVE SEALING INDICATORS** FROM THE SMALLEST TO THE BIGGEST

MIDGET SIZES
1/4" or 3/8" Line

**There is no job too large or too small for LIQUID EYE. There is a unit available for the smallest air conditioner or refrigerator to the largest size Commercial Installation in operation today.**



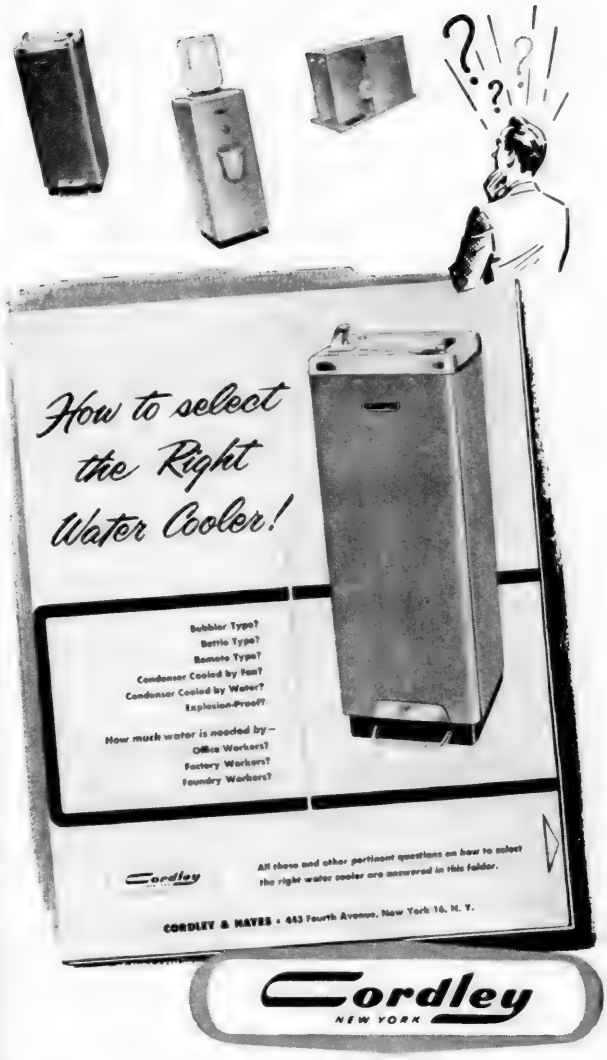
GIANT SIZES thru 1-5/8" Line

Here's why almost 1,000,000 Liquid Eye Indicators have been sold to date.

Spring loaded gaskets for positive sealing • unrestricted full-line flow • pyrex glass, double sealed at sides and ends, provides instant check of refrigerant condition • guaranteed to 500 psi. • precision made.

*Sold by leading wholesalers everywhere.*
*Send today for Catalog D-55 containing the complete Liquid Eye line.*

Allin MANUFACTURING COMPANY 1153 West Grand Ave. [illegible] Illinois
*Almost 1,000,000 Liquid Eyes Sold to Date!*


How to select the Right Water Cooler!
Bubbler Type?
Bottle Type?
Remote Type?
Condenser Cooled by Fan?
Condenser Cooled by Water?
Explosion-Proof?
How much water is needed by—
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## to water cooler selection

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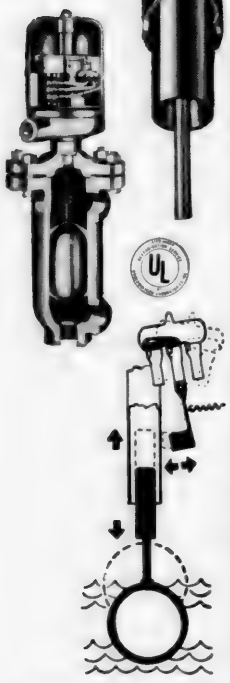

A magnetic sleeve, raised and lowered within a non-magnetic tube, "trips" or releases an Alnico permanent magnet attached to a mercury switch. Basically, this is Magnetrol.

## A Few of MANY Reasons:

**• Operating Life Is Practically Unlimited**
A PERMANENT Alnico magnet, located *outside* the float chamber, links boiler water level and electrical controls. This simpler magnetic link eliminates mechanical parts subject to wear and fatigue failure. *Pioneered and perfected by Magnetrol.*

**• Customized Corrosion Control**
Floats can be fabricated from a variety of materials to meet any "special" local corrosion problems. Type 304 stainless steel floats have proven over the years to have the greatest all-around corrosion resistance, and so are furnished as standard.

**• "No-Scale" Float Chamber Liner**
Exclusive self-cleaning brass liner actually "flexes" off corrosion—prevents scale growth and "sticking" of float.

**• Up to Three Switches—an Exclusive Safety Feature**
Only MAGNETROL design can provide up to three completely separate switch mechanisims, each operating at its own level, in a STANDARD control. Use extra switch for "stand-by" pump for emergency use; or alarm BEFORE fuel cut-off; or high level alarm; etc.

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Once-a-shift blow down and once-a-month visual inspection of switch housing are only regular maintenance. *Built SAFE, Magnetrols stay SAFE.*

We offer STANDARD Magnetrol Boiler Water Level Controls for service at temperatures up to 750°F., at pressures up to 600 psi., for single stage or multi-level stage service with up to three separate switching actions. Special units available for more extreme requirements.

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Gentlemen: Please send me Catalog Section III and full information on Magnetrol Boiler Water Level Controls.

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(*Concluded from page 160*)

**ASRE MEETING**—52nd annual meeting of the American Society of Refrigerating Engineers, at the Sheraton-Gibson Hotel, Cincinnati, Ohio. R. C. Cross, secretary of the Society, 234 5th Ave., New York 1, N. Y. . . . . **JUNE 3-6, 1956.**

**NDHA MEETING**—47th annual meeting of the National District Heating Association, at the Inn and Lodge, Williamsburg, Va. J. F. Collins, Jr., secretary-treasurer of the Association, 827 N. Euclid Ave., Pittsburgh, Pa. . . . . **JUNE 4-7, 1956.**

**PLUMBING AND HEATING EXPOSITION**—1956 National Plumbing and Heating Exposition, in conjunction with the 74th meeting of the National Association of Plumbing Contractors, Inc., to be held in the Milwaukee Auditorium, Milwaukee, Wis. Secretary of the Association, 1016 20th, N. W., Washington, D. C. . . . . **JUNE 11-14, 1956.**

**OIL-HEAT SHOW**—21st National Oil-Heat and Air Conditioning Exposition, at the new Coliseum, New York, N. Y., to be held concurrently with the 34th Annual OHI Convention of the Oil-Heat Institute of America, with headquarters at the Park Sheraton Hotel, New York. R. H. L. Becker, managing director of the Institute, 500 Fifth Ave., New York 36, N. Y. . . . . **JUNE 11-16, 1956.**

**ASME MEETING**—Semi-annual meeting of The American Society of Mechanical Engineers, at the Hotel Statler, Cleveland, Ohio. Secretary of the Society, 29 W. 39th St., New York, N. Y. . . . . **JUNE 17-21, 1956.**

**TESTING MATERIALS MEETING**—59th annual meeting of the American Society for Testing Materials, at the Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. . . . . **JUNE 17-22, 1956.**

**ASHAE MEETING**—Semi-annual meeting of the American Society of Heating and Air-Conditioning Engineers, Inc., at the Shoreham Hotel, Washington, D. C. A. V. Hutchinson, secretary of the Society, 62 Worth St., New York 13, N. Y. . . . . **JUNE 18-20, 1956.**

**INSTRUMENT SOCIETY EXHIBIT**—11th annual Instrument-Automation Conference and Exhibit (International), of the Instrument Society of America, at the new Coliseum building, New York, N. Y. J. McCaffery, assistant executive secretary of the Society, 1319 Allegheny Ave., Pittsburgh 13, Pa. . . . . **SEPTEMBER 17-21, 1956.**

**AGA CONVENTION**—Annual convention of the American Gas Association, at the Auditorium, Atlantic City, N. J. Secretary of the Association, 420 Lexington Ave., New York 17, N. Y. . . . . **OCTOBER 15-17, 1956.**

**ASA MEETING**—38th annual meeting of the American Standards Association, in conjunction with the Seventh National Conference on Standards, at Hotel Roosevelt, New York, N. Y. Secretary of the Association, 70 E. 45th St., New York 17, N. Y. . . . . **OCTOBER 22-24, 1956.**

**ASRE CONVENTION**—Semi-annual meeting of the American Society of Refrigerating Engineers, at Hotel Statler, Boston, Mass. Secretary of the Society, 234 Fifth Ave., New York 1, N. Y. . . . . **NOVEMBER 25-28, 1956.**

**ASME MEETING**—Annual meeting of the American Society of Mechanical Engineers, Hotel Statler, New York, N. Y. Secretary of the Society, 29 W. 39th St., New York, N. Y. . . . . **NOVEMBER 25-30, 1956.**

**CHEMICAL EXPOSITION**—9th National Chemical Exposition of the American Chemical Society, in the Cleveland Public Auditorium, Cleveland, Ohio. Secretary of the Chicago Section of the Society, 86 E. Randolph St., Chicago, Ill. . . . . **NOVEMBER 27-30, 1956.**

**ASHAE EXPOSITION**—International Heating & Air-Conditioning Exposition, at the International Amphitheater, Chicago, Ill. E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N. Y. Exposition held in conjunction with the 63rd annual meeting of the American Society of Heating and Air-Conditioning Engineers, Inc. A. V. Hutchinson, secretary of the Society, 62 Worth St., New York 13, N. Y. . . . . **FEBRUARY 25-MARCH 1, 1957.**

**METALS CONGRESS AND EXPOSITION**—10th Western Metal Congress and Exposition, sponsored by the American Society for Metals, and other technical groups, at the Pan-Pacific Auditorium and the Ambassador Hotel, Los Angeles, Calif. W. H. Eisenman, managing director of the Society, 7301 Euclid Ave., Cleveland 3, Ohio. . . . . **MARCH 25-29, 1957.**

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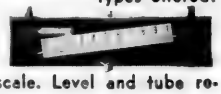

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Accurately indicates air flow resistance in duct at air filter. Easy-read white enamel scale. Level and tube replaceable on the job. Easily installed.

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High powered, free floating diafram. Accurate pointer mechanism floats on knift-edge bearings. Easy to read—readily installed.

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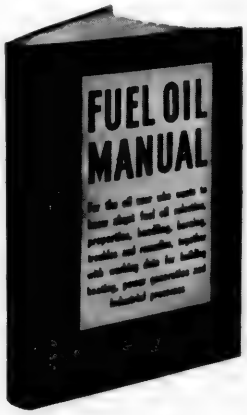


**Here is a book that will give you a comprehensive picture of the characteristics and uses of every type and grade of fuel oil. The author explains the meaning of each oil property, and shows how this information is applied to the selection, handling and burning of fuel oil. Impurities and how they effect combustion are described fully, and a special chapter describes fuel oil additives and how they are used. Another chapter lists troubles which may be encountered in using fuel oils, and shows the correct remedy to apply in each case. Technical language is avoided wherever possible, and all terms are fully explained.**

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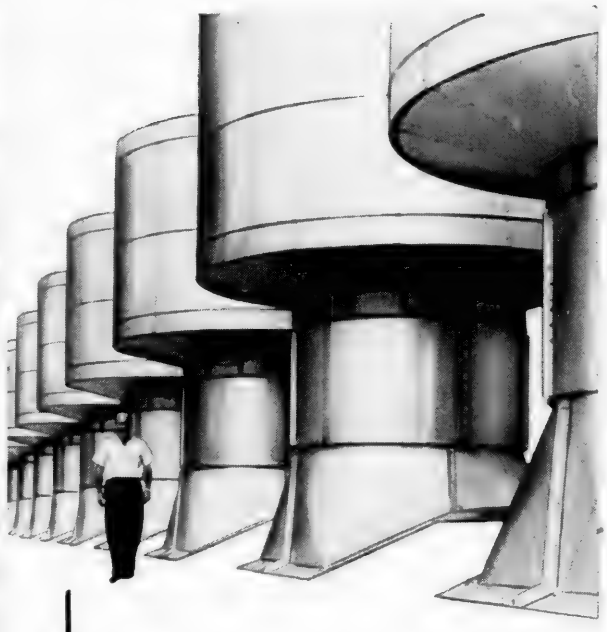

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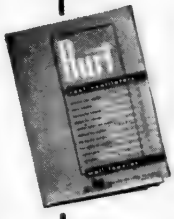
In this large steel plant, huge volumes of fumes and heated air must be exhausted during certain operations—lesser amounts during other production. Twenty-nine 72" Burt Free Flow Fan Ventilators with individual capacities of 81,000 CFM meet both needs efficiently. Burt Axial Flow cast aluminum fan wheels powered by 15HP, 860 RPM Class B insulated motors with shrouds and ventilating tubes, supply adequate air movement at peaks. At other times, their high wind band design provides extremely high air handling capacity as a gravity unit without the fan operating. If YOU need fresh air at low cost, let Burt engineers suggest—without obligation —the Burt Ventilators to do your task best.

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## NEW CATALOGS

Use the prepaid postcard on page 85 for securing your copies of catalogs described in this department.

**PIPE STRAINER BULLETIN** — A 2-page bulletin, No. 602, giving details about a line of Y-type pipe strainers is released by Armstrong Machine Works, Three Rivers, Mich. The bulletin gives details of design features, pertinent dimensions, and prices of eight sizes of cast semi-steel strainers for pressures to 250 lb. and six sizes of carbon moly steel strainers for pressures to 900 lb. ..... **Item 74**

**CONTROL OF DIRECT RADIATION** — Written in non-technical language, Bulletin CA-12, offered by Barber-Colman Co., Rockford, Ill., tells how to determine the proper control system for direct radiation. Illustrated with charts and graphs, the bulletin includes the control of steam and hot water and discusses both two-position and proportioning control. ..... **Item 75**

**CATALOG ON COOLING TOWERS** — A catalog (No. 400) describing a line of packaged cooling towers is available from Dover Mfg. Co., Independence, Mo. The catalog contains information on vertical induced draft towers, horizontal induced draft towers, and natural draft towers and the applications for each. ..... **Item 76**

**VALVE AND FITTING CATALOG**—A set of loose-leaf bulletins describing valves, fittings and supplies for ammonia, Freon, and other high pressure services is published by Frick Co., Waynesboro, Pa. Replacing Catalog O, the sections are designated as follows: valves, Bulletin 910; fittings, Bulletin 915; supplies, Bulletin 920; parts, Bulletin 925; and design tables, Bulletin 930. ..... **Item 77**

**CATALOG OF STEEL BOILERS**—A 44-page general catalog (AP-237-F) that describes and illustrates Pacific steel boilers for heating homes, commercial, and industrial buildings is available from Pacific Steel Boiler Division, Johnstown, Pa. The product literature presents ratings and capacities, plus dimensions and engineering data, for a complete line of steel boilers. To aid in quick reference, brief descriptions of boiler types, firing method and capacities are printed at the top, outside corners of the pages. ..... **Item 78**

**SPECIFICATION SHEET**—A specification sheet (Bulletin No. C-1100-S100A-P) on gas-fired, year-round air conditioners, in 2- and 3-ton sizes, is available from Worthington Corp., Harrison, N. J. The specification sheet gives dimensions and operating data for the units. ..... **Item 79**

**FILM ON REFRIGERANTS**—The problems created by moisture in refrigeration systems and how to solve them is the subject of a sound-slide film released by General Chemical Div., Allied Chemical & Dye Corp., New York, N. Y. The 35-min. film is one of a series being prepared for presentation at meetings of the Refrigeration Service Engineers Society and by wholesalers for their customers. ..... **Item 80**

**PIT PUMP CATALOG**—A 16-page catalog (No. 3007) is published by Yeomans Brothers Co., Melrose Park, Ill., covering the company's line of heavy duty wet pit pumps for applications such as drainage, flood water, effluent, boiler blow-off, hot wells, acids, and alkalis. Pictures, drawings, tables and curves discuss and describe design features of the pumps and suggest their applications. ..... **Item 81**

**RADIANT CEILING BULLETIN** — The latest developments in a radiant ceiling that heats or cools and incorporates sound control, are contained in an illustrated brochure, Bulletin No. A-138, published by Architectural Products Div., Burgess-Manning Co., Chicago, Ill. The bulletin covers a description of the three-way functional ceiling, illustrating component parts and methods of installation, as well as performance charts. ..... **Item 82**

**PVC FITTINGS AND FLANGES**—A 12-page catalog on pipe fittings and flanges in normal impact grade and high impact grade, rigid, unplasticized polyvinyl chloride is offered by Grinnell Co., Inc., Providence, R. I. The catalog lists operating pressures, temperatures, applications, price comparisons, installation and supporting recommendations, dimensions, and weights. ..... **Item 83**

**COOLING EQUIPMENT BULLETIN**—Bulletin DS-399, gives data on the range of CenTraVac centrifugal refrigeration equipment made by the Trane Co., La Crosse, Wis. Available from the company the 50-page bulletin provides engineering and capacity information on twenty sizes, including six new models in the 400-to 600-hp range. In addition to the larger units information on eight new models in the 50-to 300-hp range is given ..... **Item 84**

**OXYGEN ANALYZER CATALOG**—A 16-page catalog (55-829-56) explaining the principle, construction, operation, and features of both a paramagnetic type flue gas analyzer and an electronic recorder is released by The Hays Corp., Michigan City, Ind. A chart of major applications lists functions, examples of services, and how the analyzer is used. ..... **Item 85**

**PIPE TOOL PRICES**—The net prices of a complete line of pipe tools are given in Catalog 7596R3 issued by The Ridge Tool Co., Elyria, Ohio. The dimensions and sizes of the various tools and parts in the line are given along with the prices for each. ..... **Item 86**

**COOLING TOWER BULLETIN**—A bulletin (1255-B) of induced draft cooling towers for residential, commercial, and industrial installations is published by Peerless Products Div., United Cooling Towers Inc., Little Rock, Ark. ..... **Item 87**

**VALVE AND FITTINGS CATALOG**—A 28-page catalog (56-C) covering the complete Copperflow line of fittings and valves for copper tube plumbing, heating, air conditioning and refrigeration is issued by Keystone Brass Works, Erie, Pa. Illustrations, specifications and engineering data are included for the company's full line of copper, cast solder, flared tube and solder drainage fittings, valves and balancing valves. ..... **Item 88**

*(Continued on page 166)*

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Big Job of
Heating and Ventilating

- Capacities from 83,000 to 1,735,000 Btu per hour
- For efficient air handling from 2,000 to 28,000 cfm
- 12 basic sizes—one , two , and three-fan models
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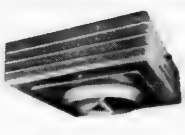
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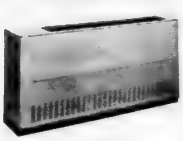
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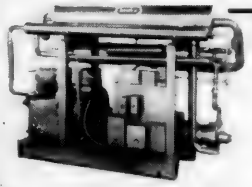

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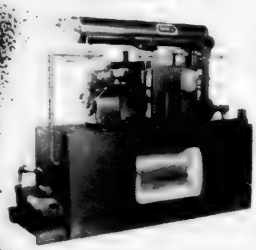

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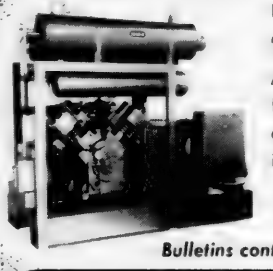

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Air cooled units available in 2, 3 and 5 H.P. models. For residential and other applications where air cooled condensing is necessary.

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# NEW CATALOGS

(*Continued from page 165*)

Use the prepaid postcard on page 85 for securing your copies of catalogs described in this department.

**OIL HEATING BULLETIN**—A bulletin describing an oil heating unit for small to medium size residences is issued by National-U. S. Radiator Corp., Johnstown, Pa. Ratings and engineering data, dimensions and tapping sizes, and the capacities and engineering data for domestic water heaters are listed. ..... **Item 89**

**AIR DIFFUSER CATALOG** — A 20-page catalog (R-86) of a new line of residential air diffusers is available from Carnes Corp., Verona, Wis. The catalog contains installation instructions, list prices and selection data for square, round, and baseboard perimeter diffusers for both heating and cooling systems. ..... **Item 90**

**WIRE AND CORD PAMPHLET**—A line of refrigeration and air conditioning wire and cord is described in a 4-page brochure offered by Essex Wire Corp., Fort Wayne, Ind. Included in the pamphlet are heater wire, internal refrigeration, room cooler and air conditioning wire, lighting circuit wire, lead wires, flexible conduit, thermostat cable and power supply cords. Data concerning size, insulation, dimensions, temperature ratings, construction, and approvals are shown. ..... **Item 91**

**RELIEF VALVE CATALOG**—A 4-page catalog covering a revised line of safety pressure and temperature relief valves for domestic hot water heaters, boilers and tanks is published by The Beaton & Cadwell Mfg. Co., New Britain, Conn. Included in the catalog are details on a self-closing temperature and pressure relief valve. ..... **Item 92**

**AIR HANDLING MANUAL**—A 40-page engineering manual, No. E.M.-G.5622, is published as a reference guide for engineers and air conditioning contractors by Drayer-Hanson, Inc., Los Angeles, Calif. It contains data on the company's line of large air handling units for commercial, industrial, and residential heating and cooling. ..... **Item 93**

**HEAT-COOLING SPECIALTIES** — A 12-page engineering catalog in color covering a complete line of heating and air conditioning specialties is issued by Maid-O'-Mist, Inc., Chicago, Ill. It highlights several new products together with illustrations on proper venting and balancing of hot water heating and chilled water cooling systems. ..... **Item 94**

**RADIANT HEATING REPORT** — Radiant heating construction is the subject of a report prepared by Engineering Service Dept., A. M. Byers Co., Pittsburgh, Pa. The report—published as an 8-page bulletin—is designed to help engineers, home builders, heating and piping contractors, and others interested in installation procedures for radiant heating. ..... **Item 95**

(*Concluded on page 168*)

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Would you like to save time? Get accurate information? A few minutes invested now may save you hours on your next job. You'll find your questions answered quickly, simply and correctly in these valuable books. Choose the ones you need and mail the coupon now. You'll be glad you did.

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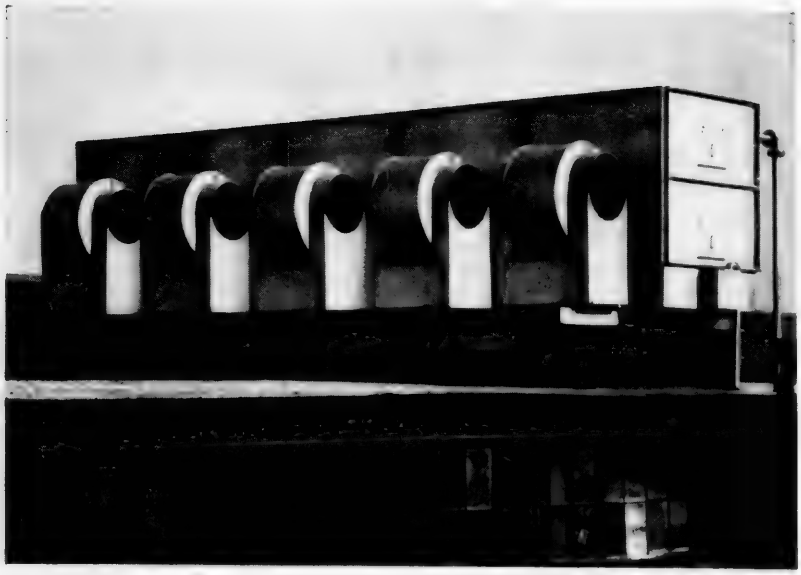

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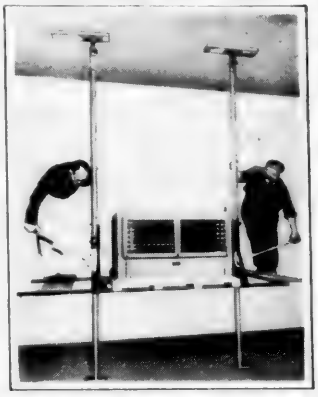

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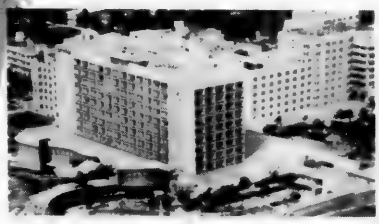

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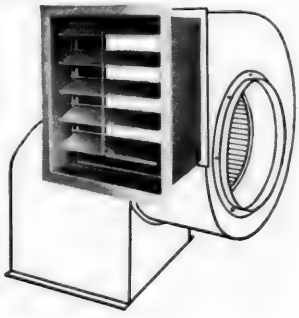

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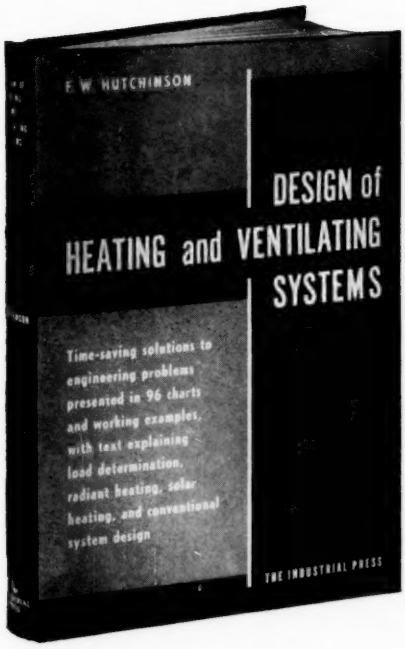
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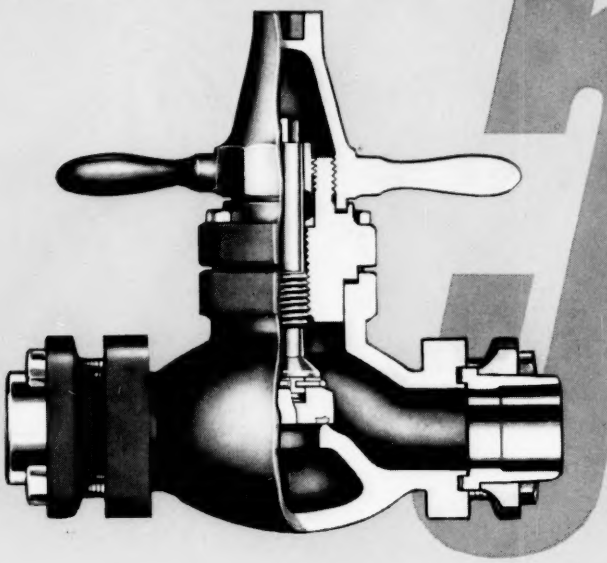

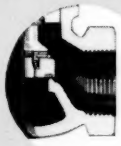

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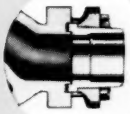

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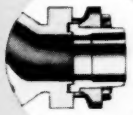

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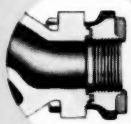

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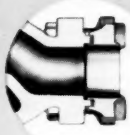

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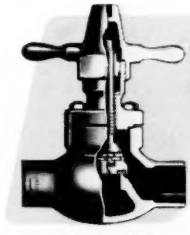
Henry offers you other features as well: Full capacity and unrestricted flow—patented self-aligning stem disc that will not rotate—resilient packing—back-seating design which permits repacking under pressure— a gasketed wing cap with socket which, when inverted, can be used to operate valve.



**BRONZE ALLOY WING CAP VALVES**

Made of bronze alloy to meet government specifications. Compact design —relatively light weight. Bolted bonnet construction and heavy wall bodies for maximum strength and safety. O.D. solder connections machined in valve body. Size range: ⅞" thru 4⅛" globe type; ⅞" thru 3⅛" angle type.

**Your favorite wholesaler has a complete line of Henry Wing Cap Valves or can get them for you.**

HENRY VALVE CO.
CONTROLLING FLOW SINCE 1914

**HENRY VALVE CO.**

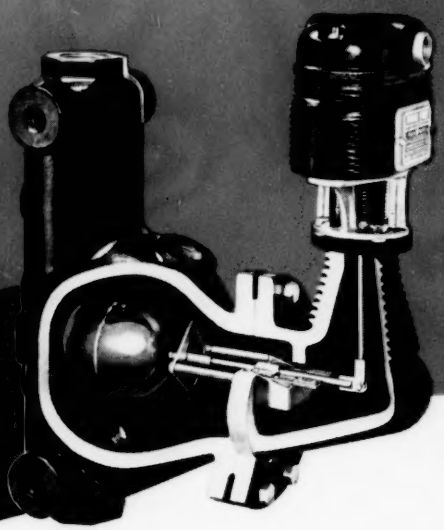
**MELROSE PARK, ILLINOIS**

(Chicago Suburb)

Cable: Hevalco, Melrose Park, Illinois

**Valves, Driers, Strainers, Control Devices and Accessories for Refrigeration, Air Conditioning and Industrial Applications.**

# yes McDONNELL Controls for boilers up to 250 psi!



**KNOW THIS 92 SERIES**

## In Four Models that meet all conditions

Here is the real answer to water level control for boilers up to 250 psi—the McDonnell 92 series providing pump control, low water fuel cut-off, and low water alarm.

This control has exactly what it takes for high pressure and temperature. Notice, for example, the generous float chamber with wide clearances between float and walls.

Keeping heat away from the switch mechanism is a foremost requirement in a control of this kind. In the 92 series an ingenious heat barrier, tapered neck, and fins, combine to effect an unprecedented heat dissipation—well proved by the fact that the 92 series complies with *current* underwriters' specification for 75°C wiring at switch terminals.

The 92 series combines a more effective use of magnetic switch actuation with McDonnell-built open contact switches—switches that do not call for the accurate alignment of the control that is necessary with other types.

There are too many features of the 92 series to cover here, but the whole story can be told in three words: *McDonnell quality throughout!* Note how the 92 series is built for you in four forms to fit right in to any boiler job requirement.

**State your conditions. Let us help you select the right 92 series control for your job. Ask for complete engineering folder on 92 series installations, and wiring sheets.**


**McDONNELL & MILLER, *Inc.***
**3500 N. Spaulding Ave., Chicago 18, Ill.**


*Doing One Thing Well*

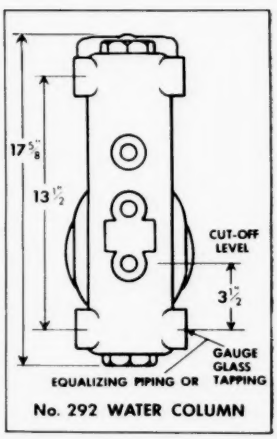
***What the 92 series does***—The 92 series does three basic jobs, singly or in combination: **(1)** controls boiler feed pump *from* the boiler—exactly as it should be controlled for maximum efficiency **(2)** provides a low water fuel cut-off—cuts current to burner in the event of a low water emergency **(3)** closes circuit for operating low water alarm whenever low water occurs. Series 92 controls are also adaptable to a wide range of industrial liquid level control applications involving pressures up to 250 psi. Upper switch includes extra circuit to gain 3 wire operator for motor operated valves.

### The Adaptable Water Column Form

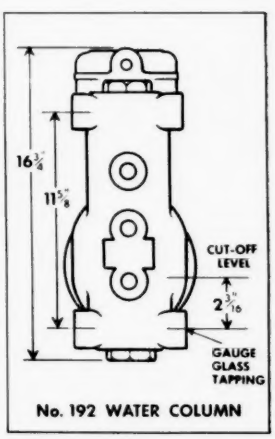
There are two 92 series controls with self-contained, water-column bodies having tappings for water-glass and tri-cocks. Water-column form simplifies installation, provides correct equalization, cuts costs and assures a trim, workmanlike job. Tappings provide for mounting control on either side of the boiler with gauge glass mounted on either side of control. The two 92 series water-column types are:

1. **No. 292** Principle dimensions shown in drawing. Note cut-off level is 3½" above center of lower gauge glass tapping. This taller body with higher cut-off point assures water level being plainly visible when located high on a big boiler. Control may be installed with either top and bottom or side equalizing connections. Gauge glass tappings may be reduced to either ¾" or ½"; tri-cock tappings, ½"; equalizing tappings, 1¼" top and bottom, or 1" side.

2. **No. 192** Dimensions opposite. Body is shorter, cut-off level lower than in 292, ideal for most fire-tube boilers. Both gauge glass and tri-cock tappings are ½"; equalizing tappings, 1¼".



No. 292 WATER COLUMN



No. 192 WATER COLUMN

### Without Water Column

These two controls have the same basic operating mechanism as 192 and 292, but are designed for installation with independent water column.

3. **No. 92** Has 1¼" top and bottom equalizing tappings.

4. **No. 92A** Has two additional 1¼" side tappings for use where equalizing piping takes this form.

No. 92

No. 92A

Your Jobber Carries Them

# McDONNELL *Boiler Water Level Controls*